Allahabad Farmer 1941

ALLAHABAD FARMER
1941

THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

MANAGING COMMITTEE

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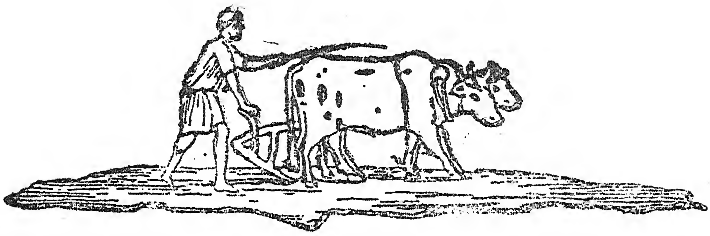


Vol. XV] JANUARY, 1941 [No. 1.

Editorial

Which came first the chicken or the egg ?

The question as to which came first the chicken or the egg may appear a very idle question and not fitting to be the subject of any serious discussion. Yet in the answer to this question lies the policies which govern cattle breeding, and in some cases, even of plant breeding, in this country. To state the problem rather bluntly, it is this. 'If the chicken came first, then if we want to get a new type of egg we must do something to the chicken so that it will produce that desired egg and then of course the chicken. On the other hand if the egg came first and we want a new type of chicken, something must happen to the egg before a different type of chicken will appear.'

Darwin (1809—1882), the evolutionist, seemed to be of the opinion that it was the chicken that came first. He believed for instance that due to changes in environment, that is, food, climate, etc. changes were produced in the chicken which

were later transmitted to its descendants. Lamarck (1744—1829) who had also followed the same lines of thought as Darwin believed that the giraffe by stretching its neck in order to reach for its food was able to transmit that character of long neck to its progeny.

However, since the discovery of Mendel's Laws a new science has sprung up known as the science of genetics which has gone deeply into this problem. Thousands and thousands of experiments were conducted with mice, guinea pigs, rabbits, poultry and fruit flies which showed that "acquired characters", that is, characters acquired by the parent during its life time, cannot be transmitted to the progeny. Professor Thomas Hunt Morgan summed up the situation by saying that "the belief in the inheritance of acquired characteristics is not based on scientific evidence."

That being so, it appears therefore to be un-scientific to believe that by feeding a cow or a chicken well one would be able to produce a new type or breed of animal. This however does not mean that cows or chickens should not be fed well. They ought to be if we are to know their maximum performance. This information is essential before we can say what the progeny of that animal is likely to perform, as the quality of the progeny depends on the characters inherited from its parents. It is also not scientific to believe that by manuring a crop one is likely to produce a new strain of wheat or barley or any other crop, much less a new species. A new variety of crop or a new breed of animal cannot be produced so easily. They can only be produced by some changes which take place in the germ plasm, that is, in the chromosomal structure of the reproductive cells; if you like, in the egg.

Selection therefore whether in plants or in animals, simply selects out the best that we find in the breed of animal or in the variety of crops. So selection has its limits. It cannot go beyond what must be the best in the breed of the animal selected, or of the variety of a crop from which selection is being made. In order, therefore, to produce a change in the chromosomal structure of a plant or an animal

place in which to live and multiply. The more successful the invasion, the more inimical they are to other plants. Living organisms become a pest when their growth remains unchecked. They overrun the fields and we call them weeds. Man after centuries of hard toil has cleared the jungle land for his agriculture. But the jungle is all the time claiming its own; it is trying to ramify and invade the cultivated areas of the farmer. And the farmer must remember that he has to maintain an incessant fight by slowly gaining knowledge of how to keep down weeds. It requires the same persistence on his part now as in the past. If there is a slight slackening on his part he will find his crop overpowered by weeds.

Weeds and the Damage they Cause:—Weeds are plants that are undesirable and hence not wanted by the farmer in his field, garden or lawn. Any plant may be a weed at times. A potato or a maize plant is a weed when it volunteers in other crops and becomes a nuisance.

Few people, probably, ever realise what a burden weeds add to human existence. The production of almost all crops largely consists of a battle with weeds. The preparation of many products of the soil for human consumption involves the elimination of weeds and their effects. Weeds may cause illness or even death in man or animals. They militate against our full enjoyment of the outdoors; they are the bane of every home owner and amateur gardener. Few human activities, in fact, are not affected in some measure by weeds...pests which increase the cost of our food and clothes, hamper our movement, menace our health and dampen many of our pleasures.

Weeds cause damage in many ways, the more important of which are as follows:—

(1) Weeds offer serious competition to crops for plant food and moisture. Probably the heaviest loss by weeds results from their competition with crops for plant food and moisture. The crop-producing power of most of our agricultural soil is limited either by the plant-food or moisture available. When the crop must share this limited supply with weeds, the inevitable result is lower yields.

(2) Weeds 'crowd' the crop restricting the amount of light, heat and air necessary for healthy growth and for the proper assimilation of plant food. The effect is to hamper the growth of the plants during early life. The straw of cereals may be weakened and rendered liable to 'lodge' thus making the work of cutting at harvest both difficult and expensive.

(3) Another heavy tax incurred through weeds is the large amount of labour and equipment necessary to keep weeds in check in those areas where they would seriously interfere with crop production.

(4) Weeds increase the cost of preparing many crop products for consumption. After the crop is grown weed contamination of the product may involve further expense in handling and processing. This is especially true of the seed crops of rice, wheat and other cereals. Most of the seed crops grown by our cultivators are contaminated with weed seed which must be removed before the seed can be used.

(5) Weeds impair the quality and destroy or reduce the value of many products of the soil. Weed contamination of many crops reduces their quality and market value. The market value of rice may be greatly reduced by the presence of certain weed seeds.

(6) Weeds serve as hosts for many fungus and bacterial diseases and for insect pests which prey on crop plants. Thus they aid in the propagation of such crops enemies which they render more destructive and more difficult to control. The bacterial organism causing bean blight lives on some of the wild legumes. Many insect enemies of crop plants may be carried over on weeds during periods when crops are not available. Nematodes and grasshoppers, so destructive of many crop plants live and multiply on many weeds. If, in fact, weeds and other uneconomic plants could be eliminated the control of many of our worst crop pests would be greatly simplified.

(7) Weeds are sometimes poisonous and many endanger the health or life of men and animals. Many domestic animals are lost annually from weed poisoning. The health

of human beings may also be affected by weeds. Deaths occasionally occur from the eating of seeds, berries or tubers of poisonous plants.

Characteristics of Weeds:—Of the many thousands of different kinds of plants in the world, fortunately but a relatively small number are weeds. The world contains some plants with a combination of characters such that they become pests; they tend to grow where not wanted; they resist man's efforts to combat and subdue them; they may resist frost, high temperature, and drought; they may be able to grow under a variety of soil and climatic conditions; they may produce enormous numbers of seeds which may live for many years in the soil; and they usually multiply and spread very rapidly. Of course, any one plant does not necessarily have all the characters which from our standpoint are undesirable but it may have a sufficient number to be a pest. Any plant which seed prolifically or reproduces vegetatively from underground parts or is poisonous to livestock or human beings or causes mechanical injury, may become a *noxious weed*.

Many weeds produce an enormous number of seeds; this truth is shown below:

Species	Approximate number of seeds per plant.
Tumble weed	6,000,000
Tumbling mustard	1,500,000
Purslane	1,250,000
Water grass	980,000
Lamb's quarters	608,000
Crab grass	204,000
Russian thistle	200,000
Black mustard	143,000
Buckthorn	118,000

The seeds of many weeds retain their vitality for many years especially when buried in the soil. For example the seeds of Shepherd's purse, mustard, purslane, pigweed, mayweed, dock and chickweed are known to live more than 30 years buried

in the soil; morning glory 25 to 30 years; ragweed 1 to 5 years. Ploughing may turn weed seeds under, placing them at depths where there is insufficient oxygen to enable them to germinate; there they remain for many years, until finally a later ploughing brings them again to the surface where they germinate. Thus a field which has for years been relatively free may suddenly develop a crop of weeds.

Manner of Introduction and Spread of Weeds:—Before the eradication and control of weeds can be intelligently dealt with, it is essential to have a clear conception of the manner in which weeds obtain access to the farm, and the methods by which they are spread amongst cultivated crops. In any particular locality weeds may come from neighbouring farms, from other areas in the district or province, from other countries. Time and time again a certain weed has been introduced into a locality, the infestation at first being confined, possibly to a few square yards or represented by only a few individual plants; and because of ignorance, indifference, neglect or improper methods of control, the small infestation forms the nucleus for a wider one which may spread throughout a whole country. The manner of introduction and spread are very varied, but amongst the commoner processes are:

(1) Probably the most common and effective means of introducing weeds is by the sale and distribution of *impure commercial seeds*.

(2) The introduction of weeds into new localities is strikingly often traceable to operations connected with transportation by means of rail or ship of agricultural plant or animal produce. Seeds are conveyed in screenings, in baled hay, in the packing about trees and in feed stuffs. As these materials are transported from place to place by railway, cars or trucks, portions may jostle out and scatter seeds along the way Some weed seeds which may occur in screenings, baled hay or other feed stuffs will pass through the digestive tracts of animals unharmed and consequently be spread on the field in manure.

(3) Weed seeds are conveyed in dirt and sand which are transported from place to place and employed in construction work, such as embankments, fills and grades.

(4) Weed seeds are distributed by means of mud and dirt on the feet of animals, farm labourers, the wheels of vehicles or the rubber casings of automobiles.

(5) Weed seeds are introduced from one farm to another by means of farm carts, implements, threshing machines, etc. The seeds stick on to the tyres of carts, the bodies of ploughs and they drop off at the time of cleaning or using them. Some weeds are dragged by ploughs, cultivators and harrows from one area to another. Plants like the bindweed, *Clerodendron Phlomides*, *Aristolochia bracteata* may occur in patches in a field and when it is ploughed the underground stems and roots get broken and spread all over the field, infecting the whole area.

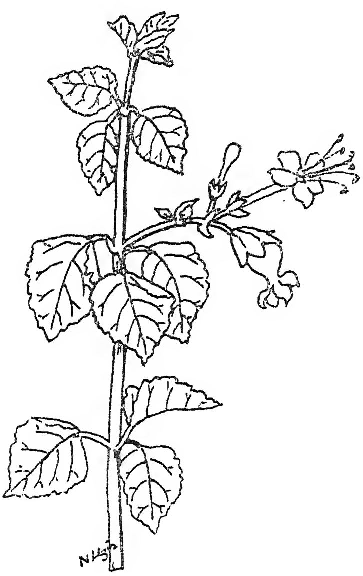


FIG. 1.—Clerodendron phlomides.

(6) Farmyard manure is often the chief source of contaminating fields with weeds. Cattle go out for grazing to all sort of waste places where weeds are abundant and feed on them. The hardy seeds are excreted undigested in the dung which is stored and applied to fields.

(7) Some weeds are adapted for dispersal by wind, some by water and some by animals. Plants of the *Compositeæ* family have usually *pappus* or *tufts* of hairs on the top of the small seed-like fruits. These hairs enable the fruits to travel very long distances by the help of the wind. Water also aids the dispersal of weed seeds. A great number of weed seeds will float on water, which, in the irrigated sections is known to be one of the most important means of spreading weeds. The seed of *Nymphaea* is enclosed in a sac-like structure in which is enclosed a small air bubble which helps the seed to float and travel for some time and when the air

bubble escapes the seed sinks down under water. Fruits of *Xanthium strumarium* are carried over long distances by water.

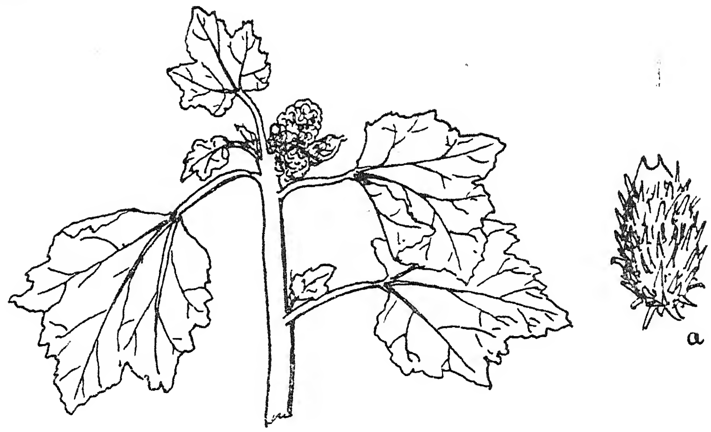


FIG. 2.—Xanthium strumarium.

Birds, animals and man are also responsible for the introduction and spread of weeds. The seeds of *Croton sparsiflorus* somewhat resembles beetles and may be picked by insectivorous birds and thrown away when they are found to be useless. *Abrus precatorius* has very brightly coloured seeds that are exposed when the pod breaks open and attract the attention of birds. Fruits of *Tribulus terrestris* are provided with sharp spines that run into the soles of bare-footed pedestrians who remove them at once and throw them away thereby doing a service to the weed. In *Achyranthes aspera* the old fruits point downwards exposing the spine-tipped bracteoles that easily get caught on the clothing of people passing by or on the skin of animals and are carried and dispersed by them. *Pupalia atropurpurea*, *Tragus racemosus*, *Triumfelta rotundifolia* have hooks on the fruit coats or on the bracts that help dispersal by the agency of animals like sheep and goats.

Factors which Influence the Spread of Weeds:— Various factors favour the abundance, increase and spread of weeds, and these although more or less interrelated may be grouped under the following heads:

(1) *Deforestation* :—Forests often attain such density that they cut off so much light as to insure the absence of all undergrowth. But when the latter are cut down the undergrowth grows with greatly increased vigour and if once allowed to develop is more difficult to subjugate them.

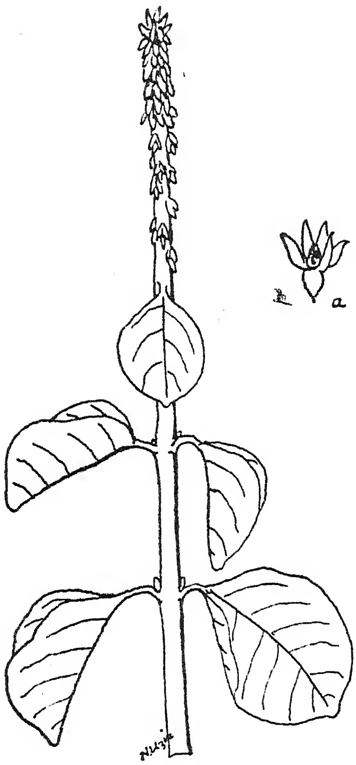


FIG. 3.—Achyranthes aspera.

(2) *Pasture Methods* :—Few conditions are more favourable to the spread of *obnoxious weeds* than the open unrestricted grazing. The animals wander to and fro distributing the burred, prickly, hairy or adhesive seeds of various weeds as they go and continually select and eat out the better pasture plants. Obnoxious, prickly, woody and poisonous plants are usually left untouched by healthy, wellfed stock and their growth is favoured by the continual grazing of the good fodder plants... the weeds are favoured and the useful plants are suppressed.

(3) *Grass and Forest Fires*:—The action of these in favouring the spread and increase of weeds is two-fold. In the first place, the removal of the original vegetation provides the conditions and in part acts as a stimulus to the germination of the seeds of weeds lying dormant in the soil. In the second place burning off the vegetation means a loss of humus. Repeated fires favour the survival of plants whose demands are easily satisfied, and which have either air-borne or long-lived seeds. To this class most weeds belong. Its modest demands enable the weed to develop on an impoverished soil, on which long-lived seeds are ready to spring up as soon as the way is cleared for them while air-borne seeds

are continually carried to the newly-cleared ground from neighbouring unburnt areas.

(4) *Drought* :—With very few exceptions no economic plants of any great value show a pronounced power of resistance to drought conditions. Most cultivated plants suffer severely, and are stunted and dwarfed, even by moderate drought. But on the contrary temporary periods of very severe drought favour rapidly growing and freely seeding weeds, or plants perennating in dry periods by means of underground bulbs or tubers. Less intense, but more prolonged and generalised drought conditions favour deeply rooting permanent weeds and encourage the survival of scrubby, spiny, or more or less leafless shrubs as well as of a few drought-resisting trees.

Classification of Weeds:—There is no one basis for the classification of the weeds. They can hence be classified from different points of view. They may be classified as *terrestrial* and *aquatic* according as they grow on land or water; as *indigenous* or *introduced* as they are natives of the locality or introduced from elsewhere; as weed of the *paddy land*, *waste land*, weeds of *play-grounds* and *roadsides*, weeds of *lawns*, etc., according to the nature of the land they infest; as weeds of *red soils*, *black cotton soils light*, *sandy soils* from the types of the soil on which they are usually found and in a number of other ways. But from the practical point of view it will be found convenient to classify weeds as *annuals*, *biennials* and *perennials* according to the length of time the weed lives.

(1) *Annuals.*—Annual weeds are those which live but one year, they produce seed but once and then die down entirely, root and all. These are usually small herbs with shallow roots and weak stems. An annual has no parts underground by means of which it is capable of spreading; it propagates itself by seeds alone which they often produce in great profusion. After seeding the annuals die away and the seeds germinate and start the next generation in the season or year following. Thus the cycle goes on year after year. Plants of this type are *Argemone mexicana*,

Stemodia viscosa and many others. In fact most of our common weeds are only annuals.

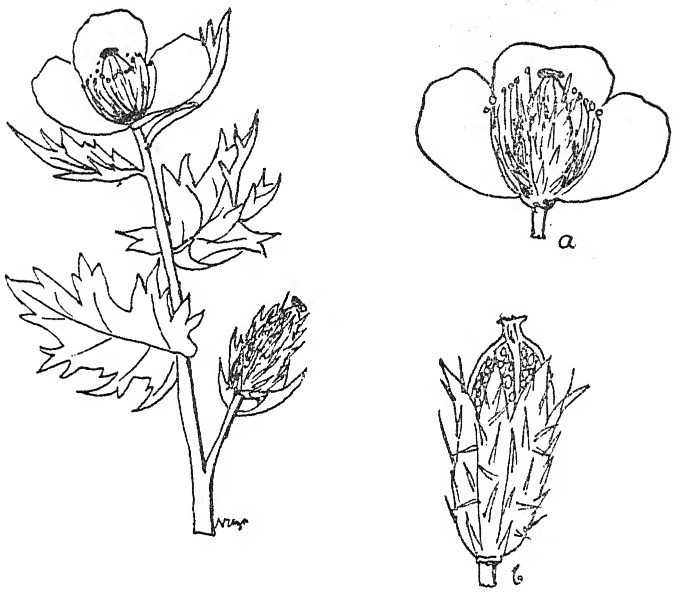


FIG. 4.—Argemone mexicana. sp. a, Flower. b, Fruit.

(2) *Biennials.*—A biennial weed is one which lives two years producing seed at the end of the second year. It is doubtful whether there are many biennials among our weeds.

(3) *Perennials.*—To this class belong some of our worst weeds. They are very well adapted to withstand adverse conditions. Plants of this group, as contrasted with *annuals* and *biennials*, live three years or more and spread not only by seed but also by the underground steams and root-suckers. *Cyperus rotundus*, *Convolvulus arvensis*, *Aristolochia bracteata* are some of the common examples.

The Problem of the Destruction of Weeds:—Weeds do great damage and good agricultural practice, therefore, necessitates their speedy destruction. From the very beginning of agriculture man has tried means after means

for the control of weeds, but in most cases, his attempts have failed either wholly, or, if lucky, partly. There is nothing to be astonished at this failure The problem of the destruction of weeds is a difficult task, and it cannot be solved by following all haphazard methods hitherto tried by the farmers. The first and the most important step in the destruction of weeds is the acquirement of detailed and definite knowledge of the life-history of the weed. If a farmer gains the knowledge of the life-history of a weed, he knows the 'weakest' point in the life of that plant and can easily check it. Before attempting any measure of control the following information should be gathered about the weed with great care and caution:

FIG 5.—Cyperus rotundus. a, Tuber.

(1) When does the weed germinate, *i.e.* when is it first seen appearing above the soil?

(2) When does it flower and bear fruits and seeds?

(3) With what special crop or crops it is particularly associated?

(4) What is its general effect on the crop? and

(5) Can it be utilised for cattle fodder or for any other purpose ?

If a farmer studies these few simple things about the weeds that are found on his farm for at least two consecutive years, he will know everything about the life-history of those weeds, and will be in a better position to devise means for their destruction than when he was ignorant about these and tried means at random.

Eradication of the Weeds:—There are four possible methods that can be tried for the eradication of weeds. They are as follows:

(1) By the introduction of a parasite which is either a fungus or an insect.

(2) By the spraying of herbicides *e.g.* copper sulphate, salt, carbolic acid, kerosene, sulphuric acid, etc.

(3) By the application of steam.

(4) By mechanical collection and destruction.

Fungus and Insect Parasite:—The control of weeds by fungus or insect pests is not simple. Though recently spectacular results have been obtained in the control of prickly pear in Australia by means of a pyralid moth *Cactoblastis cactorum* aided by two other insects *Dactylopus tomentosus* and *Chelinidia tabulata* still it is largely in the experimental stage, and, at least can only be used against a very limited number of plants without any danger. As a rule the plant-feeding insects, fungi or bacteria are not highly specialised in relation to their hosts. Most of these organisms have a wide range of hosts. It has very often been seen that an insect, a fungus or a bacterium employed to control a certain weed has turned its attention to some other plant of great economic importance. Thus *Thecla echion* imported into Hawaii to destroy the flowers of Lantana has been found to attack brinjal. an absolutely unrelated plant, one being a *verbena* and the other a *solanum*. Besides the parasitic nature of these organisms has been found to be much influenced by the environment.

Very often strangely different habits are observed in the same organism, only due to a change in their environment. In the case of the beetle *Elytroteinus substruncatus* it has been seen that in Fiji it bores into the stems of begonias but in Hawaii the same insect is a pest of ginger, and in the Cook Islands is recorded as attacking lemons.

Again, an insect or a fungus that attacks the young shoots of the plant and causes die back, may, if the attack is not sufficiently serious or is only seasonal, lead to branching and render the plant more densely shrubby, leading to a greater flowering and seed production.

Yet another danger in biological control of weeds is that when the weed to be controlled covers large areas, and the controlling agency is one which actually kills the plant, the result of the introduction, if successful, is the sudden opening up of these areas for colonisation by other plants. The plants most likely to take advantage of these newly-opened lands are other weeds. In Australia where control of prickly pear by biological agencies has been so successful, it has been found that if fire runs through the masses of dead pear a dense growth of Mallee type comes up, even more difficult to handle than the weed was. In Fiji also, on certain waste areas *Clidemia hirta* is being replaced by *Stachy tarpheta* and *Solanum torvum*, weeds far worse than the former.

A consideration of the above dangers will manifest the limited scope of biological methods in weed control. It is very safe, therefore, to conclude that biological methods in controlling weeds should be tried only when other methods have been completely exhausted.

Herbicides:—Chemicals have been used extensively and are also used to-day in some countries for the killing of weeds. And it has been reported that, in numerous instances, chemicals intelligently used have been found more expeditious and economical in the destruction of weeds than any other means for weed eradication.

Any soluble chemical, even including the various commercial fertilizers, if used in sufficient amount, will kill

plants. On the basis of their type of action the herbicides can be classified as follows:

(1) First substances which by their osmotic action plasmolyze cells and prevent plant so treated from obtaining water. An example of such a substance is common salt.

(2) A second class includes those chemicals which by their physical action dissolve or dilute protoplasmic constituents and disorganise the cell by changing its permeability and other physical properties; substances belonging to this class are the hydrocarbons.

(3) A third type includes chemicals commonly called 'protoplasmic poisons' which kill enzymes, coagulate proteins or combine with other constituents of the protoplasm and bring about a cessation of the life-processes in the cells. Examples of chemicals belonging to this group are mercuric chloride, cyanides, copper salts, iron salts, etc.

(4) A fourth type includes gaseous poisons like sulphur dioxide. These react with the respiratory pigments of plants and interfere with the oxidation-reduction balance in cells. The '*respiratory chromogens*' are either completely oxidised or decreased in number. The cells fail to take in oxygen and consequently life-processes come to a standstill.

There are a large number of chemicals that are available for utilization as herbicides. But effectiveness, cheapness and convenience of application are the things to determine choice among the various compounds available. Without attempting to list all of these, we include those whose worth has been best established by trial:

(1) *Sodium chloride.*—Salt is more commonly used than any other compound, chiefly because of cheapness and handiness. It should be applied dry or in strong solution; and it is most effective in hot, dry weather.

(2) *Copper sulphate.*—This is more powerful in herbicidal action than salt, but its costs prohibits its general use. For most purposes it is best used in solution, 2 to 10 per cent being effective.

(3) *Kerosene.*—This and other coal-oil products will kill plants. Because of handiness it is frequently used, but

it is weak in efficiency, relatively more costly than some of other common chemicals. A pint of crude carbolic acid will do better service than two gallons of kerosene, and costs much less.

(4) *Carbolic acid.*—This is one of the quickest and most valuable herbicides. The crude acid is relatively cheap. It is not quite equal to the arsenical poisons for penetrating the soil or in lasting effects, but it is often preferable because of cost or convenience. An effective method is to squirt the strong acid from an ordinary oil can on the roots or crown of individual weeds. If it is to be sprayed or sprinkled broadcast on the foliage or ground, it should be diluted with 15 to 30 parts of water and this mixture agitated frequently during use.

(5) *Sulphuric acid.*—This, of course, is destructive to everything it touches. It can be applied in the crown or about the roots of coarse or specially hardy plants. Aslander lists upwards of 50 species of weeds reported by different authorities to be destroyed by sulphuric acid solutions of various strengths, varying from 3·5 to 10 per cent.

(6) *Caustic soda.*—A strong solution of this makes a cheap and effective herbicide, commended especially for pouring on soil where it is desired to destroy deep rooted or woody plants. Of course soil so treated will be rendered sterile for some time, but the soda will gradually leach away. Like salt, this is most effective if applied in hot, dry weather.

(7) *Arsenical compounds.*—One or another of the soluble arsenical compounds form the most effective herbicides known. The simplest to employ is arsenate of soda. This needs only to be dissolved in water for use, at the rate of one pound in three to nine gallons of water.

A question of importance in the use of chemicals for weed eradication is the possibility of such compounds exerting a harmful effect on the soil with risk of injury to the subsequent crop. Some investigations on these lines have been carried out by Bowser and Newton both in the field and green house and under controlled conditions. The liability of damage depends in part at least on the rate of decomposition

of the chemical, its rate of movement in the soil and its effect on microbiological activity. Sulphuric acid and copper sulphate which are employed chiefly as leaf-sprays showed no lethal effect on the soil and nitrification was not affected. Sodium chlorate on the other hand, which is mainly used for the eradication of hardy perennials, remained undecomposed for a considerable time—poisonous effects lasting nearly two years after application has been made.

Steam.—'Live' steam has been used extensively in some countries for killing weeds, but in almost all cases it has failed to meet the desired end. The failure was due to the fact that the steam only came in touch with the leaves and stalks which were split and discoloured by the steam, but it failed to reach the buried roots in the soil. The result was that new shoots appeared in a short time from the scalded plants. The use of steam for the destruction of weeds is limited for the following reasons:

(1) It is a very costly affair ;

(2) When steam is turned into unploughed ground, it kills only the shoots of plants, while the roots remain alive ;

(3) When the field is ploughed and cross-ploughed in order to expose the roots of the weeds to the action of steam, it is successful to a greater extent than when applied to the shoots. But in this case too, it fails to reach all the roots some of which lie concealed in the soil. And if one escapes death it invades the whole field again ;

(4) When 'live' steam is passed into the soil, it kills all forms of life in the soil especially the nitrifying bacteria, hence there is the greatest danger of the soil becoming sterile ;

(5) When steam is passed into the soil it lowers the humus content of the soil, and destroys a number of plant food substances ; and

(6) Steam cannot be passed into a soil where a crop is standing.

From all these considerations it is quite evident that the use of steam for killing weeds is impracticable and entails a great expenditure with least outcome. Steam therefore cannot be profitably used for the eradication of weeds.

Mechanical Collection and Destruction:—Practical experience shows that a better method of weed eradication in comparison with those that have been described above is the collection and destruction of the weed. To some the cost of labour for this purpose may at first sight appear prohibitive, but a thorough study will reveal the fact that this method is more efficient and economical in the end than the others described above. But it should be remembered that, in order to get the most satisfactory results, they should be collected at a definite time. For this as has been mentioned above a thorough study of the life history of the plant should be made, the different modes of its reproduction studied, and the plant attacked at the most vulnerable point in its life-cycle. The plants should be collected before flowering and seeding with all their roots. In this connection it is worthwhile to remember also that under all circumstances, weeding should be done on a sunny dry day, and when there is no possibility of rain for the following seven days at least. This gives the plants the least scope for regermination due to lack of moisture. The collected plants should be allowed to rot in a pit or composted with cowdung or other farm refuse and then applied to the field when well rotted. This method of destroying weeds has been found economical, practical and satisfactory by a large number of cultivators.

Control of weeds:—The control of weeds is more import ant than its eradication. The use of fungal or insect parasite, chemicals, 'live' steam and the mechanical collection and destruction of the weeds offer no specific cure all against them. Cultivation, rotations, and watchfulness against the introduction and scattering of weed seeds are all of more fundamental importance in combating weeds than chemicals, steam, fungal parasites and their mechanical collection and destruction. No doubt, in some special, but very rare cases chemicals, fungal parasites and steam have proved very successful, but one should not be blind to the fact that these methods adopted for the extermination of weeds are secondary rather than primary.

The measures taken to control weeds depend first of all upon whether the weed is an annual, a biennial, or a peren-

nial. It is obviously one problem to deal with perennials and another problem to deal with annuals and biennials. In the annuals and biennials which are generally propagated by seeds it is necessary only to prevent seeding so far as dissemination or persistence is concerned. A single plant of many common weeds will produce hundreds or thousands of seeds. Moreover not all of these seeds will germinate the first year, and the seedlings may continue for several years. Harrowing and cultivating farm lands not only will improve soil conditions for the growing crop but will also destroy a countless number of weed seedlings. Pasturing off the weeds with sheep, goats and cattle are efficient means of destroying weeds if practised before they come to bloom.

In the case of the perennials it is necessary to destroy or crowd out the entire plant, root and all. Perennials can thus be held in check by prevention of seeding, destruction of the top-growth and the killing of the structures beneath ground which store food. All these may be accomplished by mechanical means, such as the hoe, scythe, mower or cultivator. Destruction of the top growth may also be accomplished by chemical means, employing sprays, which may merely destroy the top growth or may also penetrate the roots or root-stocks.

The control of weeds is a major item in farm management and upon its proper management depends to a considerable extent the outcome of the business. The subject of weed control has attracted the attention of all tillers of the soil at all times and in all regimes. But the results achieved has not been very promising and satisfactory. This has been mainly due to the fact that the principles of weed control has not been strictly followed by the cultivators. In any programme of weed control the following points should be very strictly adhered to:

(1) *Crop Rotation*:—In any serious programme of weed control crop rotation plays a leading part. Among the many well established reasons for such procedure control of weeds is one of the most important. Planting land to the same crop for a series of years in succession encourages weed growth, and a lack of proper rotation is a chief cause of weedy fields.

(2) *Clean cultivation*: —Though it aims primarily at stravation of roots or underground stems of perennials also

continually keeps the soil stirred and brings seeds formerly produced by weeds to the soil surface where, under favourable conditions, they germinate, the seedlings being killed by subsequent cultivations. Thus clean cultivation serves to bring about a decrease in the number of weed seeds in the soil. If clean cultivation of a row crop is carried on for a year or two perennials are very much weakened, if not killed out.

(3) *Smothering*: -Weeds may often be suppressed or much reduced by the growth of dense, heavy smother crops which choke them out. Suitable crops for the purpose are vetches, or a mixture of vetches, peas or beans.

(4) *Clean seed*:—Under no circumstances should imperfectly cleaned seed be either purchased or sown.

(5) *Clean manure*:—Under no circumstances should cattle manure or composts contaminated with weed seeds be applied to farm lands.

(6) Roadsides and other wastes where the weeds multiply and breed should always be kept clean.

(7) New weeds when they begin to invade the neighbourhood should be recognised promptly and necessary steps taken for its eradication.

(8) Care should always be taken to prevent the top growth of the weeds; they should not be allowed to form seeds and their underground roots or rootstocks should be starved to death.

Conclusion :—Insects and plant diseases are the plagues of the husbandman. But no less are the weeds a plague to the tiller of the soil.

They rob the soil of water and food materials and do a number of other damages. The farmer should remember that all weedy fields are poorly managed fields. Nature covers all areas and Nature knows why. But the farmer in dealing with the weeds should work out such a system of crop management as will afford the weeds the least opportunity to gain a foot-hold. Efficient agriculture is an efficient management of weeds. And the dexterity and the skill of the husbandman is judged more by the cleanliness of the field than by any other one factor in farm management.

STATISTICS IN RELATION TO THE SCIENCE OF CROP IMPROVEMENT

By

M. P. Singh, M.Sc.,

Formerly Cotton Research Officer, Rangamati, Chittagong Hill Tracts, Bengal.

Part I. General Principles

The present note aims at familiarising a beginner with the various statistical principles involved in the application of the statistical theory to the two ways of effecting improvement in the crop plants *viz.*, selection and hybridization. In this article nothing more will be done than a statement of the basic principles involved, and it is the intention to deal with this article in two parts: (1) General principles, and (2) Field experimentation.

General Principles.—It is proposed to go into some detail in the various statistical methods used in evaluating the mathematical constants used to characterise a sample, as there is no other satisfactory method of handling the mass of figures collected from any experiment. The figures collected regarding an observation from any experiment are called collectively a *sample* and individually a *variate* For example, the recorded heights of 500 wheat plants from a field are collectively called a *sample* and the height of each plant a *variate*. A sample therefore consists of several *variates*. In order to grasp thoroughly the meaning of 500 height values of the wheat plants from a field, it is imperative that the data be reduced to some intelligible figure from which the necessary inferences can be drawn. It necessitates the evaluation of constants characterising the sample as aforesaid. It should be clearly borne in mind that the various constants characterising the sample are not absolute values; they are just estimates. Therefore

statistics may also be called a science of estimates. The constants or statistics generally calculated in characterising a sample are the *mean* and the *standard deviation.*

Calculation of the Mean.—The mean is calculated by dividing the total of the individual values of the variates in a sample by the number of the variates. In the above example of the heights of the wheat plants, the mean will be calculated by dividing the total of the 500 height values by 500; as the number of variates in the above sample is 500. Expressed in symbols, the mean is calculated by the formula $\frac{\Sigma(X)}{n}$ when X is the value of the variate, Σ the sign of summation and n the number of variates. With this calculation of the mean it can now be said about the sample that the average height of 500 wheat plants in the field is such and such. Even with the calculation of the mean, many things regarding the sample are left unknown. For example it is not known how the different variates in the sample are distributed round the mean or whether the differences between the values of the different variates are great or small. This shortcoming of the mean will be made clear by the consideration of the following example. If the ages of two persons be 50 and 10 years, the mean naturally is 30, and if the mean is the only information available regarding the sample, it can be concluded that both the people are young whereas the case is quite different. This shortcoming of the mean necessitates the calculation of another constant called the standard deviation. The deviation is the difference between the variate and the mean.

Standard Deviation.—This is also called as the mean square deviation, and is evaluated by adding the squares of the deviations of each variate from the mean of the sample and dividing the sum by the number which is one less than the total number of variates in the sample, and taking its square root. The deviations are calculated by substracting the values of the variates from the mean. The deviations may therefore be either positive or negative. If the mean calculated is sufficiently accurate the algebraic sum of these deviations will be zero. The divisor in the calculation of

the standard deviation is one less than the total number of variates in the sample, and is called the *degrees of freedom* which represent the number of independent ways in which the comparisons can be made. The sum of the deviations squared is called the *sum of squares* or briefly the S.S., and the sum of the squares divided by the degrees of freedom is called the *variance*. Expressed in a formula the expression for the calculation of the standard deviation is $\sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}$ where Σ represents summation and $(x-\bar{x})^2$ represents the square of the deviations from the mean and $n-1$, the degrees of freedom.

The standard deviation thus shows the degree of dispersion of the variates in a sample round its mean. A high value of the standard deviation means greater variability whereas a low value indicates less variation in the variates of the sample. Now with the calculation of the mean and the standard deviation an idea regarding the variation in the sample with its average can be formed.

The idea of a population, real or hypothetical, consisting of an infinite number of variables is fundamental in all statistical work; and the calculation of the mean and the standard deviation for any number of samples has no meaning unless it is possible to ascertain whether the samples come from the same population. To ascertain this is necessary, as it will then be possible to determine the probable nature of future samples to which the conclusions can be applied. To do this the first step is to see if the sample under observation follows a normal law, as most of the biological problems follow this law. The characteristics of a population following a normal law is that its variates take all values from $+\infty$ to $-\infty$, with the maximum number of variates aggregating round the mean which also divides the bell shaped normal curve into two equal parts. Statistically the normality of a sample is tested by calculating 'g'_1' and 'g'_2' and then testing as to by what amount the calculated values of 'g'_1' and 'g'_2' differ from zero, as for a normal curve both the 'g' statistics are zero 'g'_1' and 'g'_2' are determined by calculating the 'k' statistics and the reader is

referred to the test of abnormality for a detailed study of this test.

The Normal Curve.—Let the example of 500 heights of the wheat plants used to calculate the mean be concentrated upon. On closer examination it will be observed that either there are many plants in the sample which are of the same height, or a number of plant heights do not vary greatly and they may be easily grouped into a class. Let the 500 heights be grouped into as many classes as there are in the sample, that is, let the data be arranged in a *frequency array.* If this is now plotted on a graph paper with the height along a horizantal scale against the corresponding frequency on the vertical scale, and if the shape the graph assumes is that of a bell, with the maximum aggregation of the frequencies round the mean, the curve is said to be normal. The critical test of normality can be made by calculating 'g_1' and 'g_2' as mentioned above. Some irregularities are apt to arise in the shape of the curve especially with a small sample size and inadequate divisions of the frequency array, but with proper safe-guards the curve generally assumes the same shape and peculiarities as that of the normal curve.

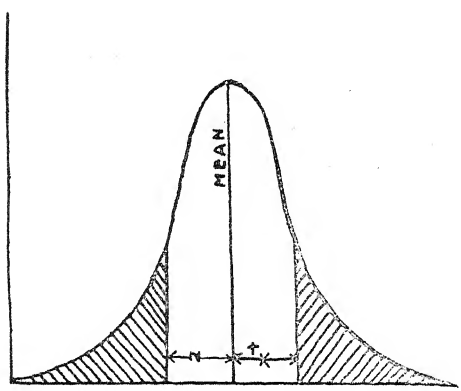
If the curve is narrow with rather steep sides it shows less variation, whereas if the curve is broad and the sides sloping gradually it shows greater variation. Mathematicians who have studied variation and have defined the normal curve hold that it is possible to ascertain the chances of selecting at random a variate higher or lower than the mean by a certain specified quantity provided the population follows a normal law.

The chances of obtaining such a variate are determined on probability or 'P' and it is better to understand the meaning of probability before proceeding further. If a coin is tossed in the air a sufficiently large number of times the chances of obtaining heads and tails are equal provided the coin is rightly made. That is to say, the probability of heads and tails is 1: 1. The chances of the four appearing in an unbiassed die is once in six trials, *i.e.* the probability of fours appearing is 1:5 or 0·16. Probability is expressed in

odds against an event occurring. In the above example of the die the odds against the appearance of the four are 0·16. It is therefore the ratio of the number of times an event happens to the total number of trials carried out.

A normal curve which is symmetrical round the mean will be divided into two unequal parts by an ordinate raised at the distance x from the mean. The area of the smaller portion shown cross-shaded in the diagram is proportional to the total frequency of the population. The total area of the curve is proportional to the total frequency of the population. The probability of selecting at random a variate exceeding M + x in value will therefore be given by the ratio of the area of the tail to that of the whole curve.

It has been proved by the mathematicians that for all normal curves the ratio x/σ (when x is the deviation from the mean and σ the standard deviation) bears a definite relation to the proportion into which the normal curve gets divided by an ordinate raised at a deviation x from the mean. When $x/\sigma = 1$ the area of the tail is always 0·15866 of the whole curve. The deviation of − x from the mean is of equal importance as that of + x in statistics, and therefore it is imperative that the probability of selecting variates $M \pm x$ be determined. The probability will be equal to the proportionate areas which the two tails (shown shaded on the diagram) cut from the normal curve. Since the curve is a symmetrical one the areas of the two tails will be equal, and the probability will just be twice that for a deviation + x from the mean.



The Normal Curve.

Tables have been compiled of all values of x/σ, which show the proportionate areas cut off by the two ordinates

raised at deviations of + x and—x from the mean. These tables are called the tables of probability integrals. The tables of x which is a modified form of the table of probability integrals has been compiled by Fisher and it gives the theoretical values of x/σ for probabilities from 0 – to 1.

Now in our example of 500 wheat plants the chances of selecting at random a variate greater than the mean provided the height records follow a normal curve can be ascertained by determining the mean and standard deviation or σ, and finding its ratio. The probability can be ascertained by reference to the table of x. This test of selecting at random a variate greater or less than the mean is only applicable in the case of large samples following a normal law.

In our example the problem is that of determining if the sample is representative of the population mean, that is to say how far the mean of 500 wheat plants can be regarded as representative of the mean of the type of wheat from which the sample was taken. One way of doing this is to draw large number of samples from the same field of the name nature as that drawn previously for calculation of the mean, and observe the difference between the different means of the samples. We conclude that there is not much difference between the sample and the population mean if the observed differences are not great. This way of working is not only impracticable, but also very laborious and time comsuming. Application of statistical theory is to overcome this defect, and the problem can be solved by calculating another value called the standard error.

Standard Error.—This measures the dispersion or standard deviation of the hypothetical population of means. It is important to distinguish between the standard deviation and the standard error. The former is a measure of the dispersion of variates from the mean of the sample, while the latter is the measure of the dispersion of the means of large number of samples from the true or the population mean. The standard error is calculated by dividing the standard deviation of a sample by the square root of the

number of variables in a sample. Expressed in symbols it is $\sigma/\sqrt{n}$ when n is the number of variables and σ the standard deviation of the sample.

The use of standard error is much wider than that of standard deviation. It can be safely used even in cases where the sample, due to its smaller size or anything else, departs slightly from normality, for it has been shown that in such cases the means of the samples tend to be normally distributed, and the use of the table of 'x' in large samples to determine the probability that the mean of the sample will differ from the population mean by a certain specified quantity can be made. In order to determine this probability the ratio of x (the deviation from the mean) and the standard error is looked up in the table of x. If the value of 'P' is large then the chances of the population mean differing from the sample mean by a certain specified quantity are great and *vice versa.*

In regular experimentation it is seldom the case that the experimenter is concerned with a single sample. He is to deal with several samples to determine if there is any real difference between them or not. From each of these samples the estimates of the mean and the standard deviation of the respective population is made. The real difference if any between these samples will be reflected in their mean values. Two kinds of differences between the means of the different samples have come to be recognised, (1) those due to real causes when the samples belong to two different populations, and (2) those due to the errors of random sampling. The former differences are genetic in origin and of great value in making selections, whereas the latter differences are environmental due to the errors of the random sampling. These latter differences are not of much value in the science of crop improvement

Test of Significance.—With the recognition of the two sources of variation affecting the difference between the mean values of the samples under comparison, the necessity of a technique capable of differentiating the aforesaid differences in the mean values will be realised. In the statistical comparison of the means the assumption made is that there

is no real difference between the means of the two samples, *i.e.* the samples come from the same population. The assumption made in the test of significance is that if a sample is distributed normally the means of such samples will also be normally distributed, and by the calculation of the standard error the measure of dispersion of the sample means will be available. Furthermore it has been shown that the differences between the variables recorded in pairs tends to be normally distributed and by calculation of the standard error of the difference between the two means, a measure of the dispersion of the differences between the variates is available. Since the differences between the variables are normally distributed, the standard error of the difference between the two means can be used in conjunction with the table of x, and the probability of this difference exceeding a certain value can be ascertained. In case the probability is small it can be assumed that the samples belong to the different populations and the difference between the means of the two samples is *significant*. In case the probability is high the samples may be assumed to come from the same population and the difference between the means to be due to unavoidable causes or due to the errors of random sampling, and it is then termed *insignificant*.

The standard error of the difference between the two means is calculated by taking the square root of the sum of squares of the standard errors of the two samples. The formula is $\sqrt{E_A^2 + E_B^2}$ when E_A and E_B are the standard errors of the samples A and B. In case the two samples consist of unequal numbers of variable the standard error of the difference is evaluated by dividing the squares of the standard errors by their respective frequencies and taking the square root of the sum. $Sd = \sqrt{\frac{E_A^2}{110} + \frac{E_B^2}{215}}$

The 't' Test.—Use of the tables of x can only be made in the case of large samples to determine the probability of a difference between the two means exceeding a certain specified quantity.

In the case of small samples generally come across in field experimentation the difference between the population

mean and the sample is high due to the small size of the sample ultimately affecting the mean, and thus with the use of the x table there is every possibility of a faulty conclusion as this difference is not normally distributed. 'Student' has compiled tables of 'z' for small samples in which the difference between the sample and the population mean is normally distributed and is expressed in terms of the calculated standard deviation of the sample. Fisher has expressed the difference between the sample and the population mean in terms of the standard error of the sample and has modified 'Student's' 'z' table to a 't' table. The 't' table has been compiled for 1 to 30 and ∞ degrees of freedom for probabilities from 0·01 to 0·9.

To ascertain the probability of a sample differing from the population mean, one has only to calculate 't' by the foumula t = deviation of the mean / standard error of the sample, and to base his conclusions on the value of probability.

In cases of comparison between the means of two samples the 't' test is applied by dividing the difference between the two means by the standard error of the difference of the two means or $t = D/Ed$ when D is the difference and Ed the standard error of the difference. This value of 't' can be looked up for a certain level of probability for appropriate degrees of freedom which is always one less than the number of samples under observation. The level of probability generally worked with in field experimentation is 0·05. If the value of the calculated 't' shows a high probability, then the samples under observation differ significantly and belong to different populations. In the case of low probability the differences are considered insignificant, the samples having come from the same population.

Chi-Square Test.—In biological research it is not always the problem of ascertaining if the samples come from the same population. Often it is of interest to judge if the observed facts conform to some established hypothesis as is generally the case in Mendelian investigations It should be realised that here too an infinite number of samples is out of the question, and only a portion of the data is available.

This at once suggests the question as to what degree of discrepancy can be allowed between the observed and the expected values. The test which measures this is called the Chi-square or χ^2, and is used to determine the goodness of fit between the observed and the expected values.

Chi-square can be culculated by the formula $\Sigma (x^2/m)$ where x^2 represents the square of the difference between the observed and the expected class and *m* the expected value in any one class. The value of χ^2 is therefore based on two things, (1) the difference between the observed and the expected class, and (2) the number of independent comparisons available. The latter is the number of degrees of freedom which can be attributed to the estimate of χ^2. The theoretical distribution of χ^2 has been worked out by statisticians and this distribution can be used on the same principle as that of the normal distribution to determine the probability of exceeding any calculated value of χ^2 due to the errors of random sampling. From this distribution of χ^2, tables have been compiled from which the probability can be determined for degrees of freedom from 1 to 30. Ift he value of χ^2 is high the discrepancy between the observed and the expected is great and the chances that the hypothesis is correct are small. In case the value of χ^2 is low the discrepancy between the observed and the expected is small and the chances that the hypothesis is correct are greater, the discrepancy if any in this case between the observed and the expected being attributed to the errors of random sampling. The χ^2 table is used with appropriate degrees of freedom which is always one less than the independent classes in the sample. For degrees of freedom higher than 30, statisticians have shown that the expression $\sqrt{2\chi^2} - \sqrt{2n-1}$ may be used to calculate the value of χ^2 for the sample. The errors of random sampling for $n=30$ are small and become progressively smaller for higher values of n.

Chi-square has found a general application in the genetical research where it is necessary to see if the observed values are in conformity with the expected values.

Test of Homogeneity.—Imagine an F2 generation with several families. The χ^2 for the whole F2 indicates

a significant discrepancy between the observed and the expected values, meaning thereby that there is some trouble with the families constituting the F2 generation. To test the homogeneity of the F2, χ^2 is evaluated for each of the F2 families and is tested independently. The family which shows a discrepancy between the observed and the expected is concentrated upon to find the cause of the discrepancy. By this use of the test of homogeneity, many obscure linkages, etc., were brought to light and explained.

Test of Independence.—In a population, say of cotton plants, the observations regarding yield can be grouped in more than one way. The high and low yielding plants can be classified both according to the flower colour, yellow and white, and according to the leaf shape narrow and broad. Often it is of interest to learn if the high yielding plants are influenced by the above factors, or the difference between the classes if any is mainly due to chance. This is done by arranging the high and low yielding plants with respect to flower colour or leaf shape in a 2×2 contingency table, and then calculating in each sub class the number of plants that might be expected on the assumption that the yield and flower colour or leaf shape are independent. This calculation is done by dividing the total number of the plants of one class, and then of another class in the proportion of high to low yielding plants. It will be clear that if only one expected value is calculated the rest of the values can be filled in by substraction from the totals in the rows and columns of the table. Chi-square is evaluated to see if the discrepancy between the observed and the expected is merely due to chance or the proportions within each class are actually influenced by the other factor. Since a single expected value determines the remainder in the case of a 2×2 contingency table, there is only one degree of freedom for the calculated χ^2, and if its value is higher than that of the observed χ^2 from the table at the 0·05 level of probability, the discrepancy between the observed and the expected values is real and it can be concluded that one class had an influence over the other class. In the event of the discrepancy being due to chance only the classes in the contingency table are independent.

In this test of independence more than one factor can be introduced as well; the process will only be an extension of 2×2 contingency table, but the principle involved will be the same. The same population of the cotton plants may be classified into high and low yielding, yellow and white flower colour, and narrow and broad leaf shape. The expected ratios are worked out for each class as aforesaid and the χ^2 calculated for each class, and then finally added to determine the real or chance discrepancy.

Correlation.—In biological research it is not uncommon to come across an association between two factors. It is a common experience that yield is associated with plant numbers, that is an increase in the latter is associated with corresponding increase in the former and *vice-versa*. Under these circumstances yield and plant numbers are said to be positively correlated. Characters which have an opposite association with each other as is the case between the lint length and ginning percentage in cotton, where an increase in the former is associated with a corresponding decrease in the latter are said to be negatively correlated. The figure which measures the degree of association between two factors is called the coefficient of correlation symbolised as 'r'. The correlation coefficient may be either negative or positive depending upon the presence of positive or negative correlation. The calculation of the coefficient of correlation or 'r' is done by the formula $r = \text{covariance } xy / \sqrt{\text{variance } x \times \text{variance } y}$ where the covariance xy is the sum of the products of the deviations from the means of the variables x and y, and variance x and variance y are the sum of squares of the deviations from the mean of each variables x and y.

The calculation of the coefficient of correlation entails a lot of arithmetic and it is useful first to ascertain by means of a dot diagram if there exists any correlation between the two variables. This is done by plotting the value of one variable against that of another on a squared paper. The dot diagram is then divided into four quadrants by drawing perpendicular and horizontal lines from the means of the two variables, and if the majority of the dots lie diagonally on the right or left hand side they are correlated positively

or negatively respectively. In case the dots are scattered all over and no definite direction of the majority of dots can be made out, then they are not correlated. The dot diagram is also known as a correlation table.

Sampling.—It should be realised that in all statistical work the idea of a population is gained from a small number of individuals of the population. So in order that the inferences regarding the population may be correct, it is imperative that the individuals from a population selected for the study of the sample should be of adequate size. With small samples the normal curve is not adequately arrived at, and the application of the formulæ based on the normal curve will naturally lead to erroneous conclusions. Besides being adequate in size, the sample drawn should be strictly at random, *i.e.* all the variates of the population should have equal chances of being included in the sample. For in its absence the results arrived at will cease to be universally applicable, and will be biased instead. The third criterion of a sample drawn for experimentation is that it should be homogeneous; that is to say, that the individuals comprising it should be of the same general type.

Several methods of drawing samples for experimental purposes are in vogue, and they all aim at the same mark *viz.*, random sampling, adequate sample size, etc. The learning of the use of the random sampling numbers table compiled by Tippett will greatly facilitate the solving of the problem of sampling.

(To be continued).

THE CONTROL OF STORED GRAIN PESTS

1. Carbon disulphide at the rate of 5lbs. for 1000 cu. ft. space is very effective. The cost of carbon disulphide is about Rs. 2-6-0 per lb. The material, however, should be used with discretion as it is very inflammable and therefore may cause explosion.

2. Cyano-dust at the rate of 2lbs. per 1000 cu. ft. of space is sometimes used. But this requires expert handling as it is very poisonous and may cause death to persons as well as animals. The price of this is about Re. 1 a lb.

PREPARATORY CULTIVATION FOR WHEAT IN MALWA

L. SWARUP,

G. G. TAMBE AND S. C. TALESARA,

Institute of Plant Industry, Indore, C. I.

While investigating possible lines of improvement in the methods of cultivation of unirrigated wheat under local conditions, it was observed that the Malwi cultivator very often leaves his land without weeding and cultivation till the end of the rains, then cultivates it two or three times with a *bakhar* and sows wheat about the end of October. To test how far this practice was sound and whether it could be improved the following investigations were made.

In the year 1932, a replicated randomised experiment was laid out to compare (on wheat following a clean monsoon fallow) the influence, if any, of soil inversion by Ransome's CT 2 plough, close ploughing with a *desi* plough and a single cultivation with a *bakhar* at the end of the rains. The influence of interculture on the growing wheat crop after these treatments was also tested. The re ults are given in the following table :—

TABLE I

Influence of cultivation on soil tilth, moisture, and wheat yields.

	Interculture.			No interculture.		
	A Ploughing 3" to 4" deep.	D No cultivation.	E Ploughing by CT 2 Plough 6"-7" deep and inversion.	B Ploughing 3"-4" deep.	C No cultivation.	F Ploughing by CT 2 plough 6"-7" deep and inversion.
(1) Tilth index ..	7·3	9·9	6·4	6·4	11·6	5·6
(2) Total moisture (4" 8" depth) .	16·5	16·3	16·4	15·5	16 9	17·6
(3) Wheat grain (mds. per acre)	4·6	4·8	4·5	4 8	4 3	5 1
(4) *Bhusa* (mds. per acre)	10·69	11·58	10·23	11·09	10·91	11·19

There was no significant difference observed in the yield of either grain or *bhusa*.

Another experiment in 1932 compared the effect of complete removal of weeds during and after the rains, before preparing the land for wheat, with weeds left to grow during the rains and mixed with the soil during subsequent cultivation with a *bakhar*. The results are shown below:—

TABLE II

Treatment.	Yields of grain and *bhusa*.	
	Grain per acre in mds.	Straw per acre in mds.
Weeds removed ..	9·71	22·8
Weeds left to grow ..	9·56	23·0

Curiously enough, no significant difference due to the treatment was observed in the yields of either grain or *bhusa*. These experiments seemed to indicate that the local

level of soil fertility was little affected by the growth of grasses or weeds during the rains and that it was immaterial whether the soil was subsequently worked deeply or was given adequate surface tilth. The only point which remained uncertain was the exact period when the tilth really operated.

In 1934, six varieties of paddy were grown in the monsoon and were harvested at varying intervals after the cessation of rains according to their rates of maturity. After the harvest of each variety the plots were ploughed and left fallow—except for that of the variety which was the last to harvest. The whole field was then cultivated with a *bakhar* once and sown with wheat. Differences in the early start and growth of seedlings began to appear between plots previously under different rice varieties. In order to ascertain whether the different dates of harvest or the varieties were responsible for this, the yields of grain starts drying after the rains cease. This is usual under the local practice wherein the first cultivation with a *bakhar* starts as soon as the heavy rains cease.

It is also equally curious that the deeper working of the soil makes no difference in yields. The favourable influence of surface mulch obtained early in October seems to be due to the combined effect of the hot and dry winds during the day alternating with the condensation of moisture in the night. It is well known that nutrients are released by heating of clay and alternate drying and wetting restores the crumb structure, thus producing a fertile seed-bed of fine tilth, so essential for even germination and vigorous start of the seedling crop. Such a crop seems to find no difficulty in securing all its needs afterwards. It seems possible that a profitable catch crop like paddy or soya beans which can be removed from the soil before it begins to dry at the end of the rains can easily be introduced in the rotation without detriment to the wheat crop so long as the soil remains vacant during October. It is quite clear that material calculated to improve the activity of the clay complex should most suitably be incorporated in the soil before this period.

THE USE OF REVENUE SETTLEMENT RECORDS FOR AGRICULTURAL WORKERS.

By

LAKSHMAN SWARUP, *Agricultural Officer, Alwar State,*
KANWAR AMAR SINGH, *Director of Agriculture and Grass Farms, Jodhpur State,*

AND

R. K. AURANGABADKER, *Institute of Plant Industry, Indore, Central India.*

Agricultural Departments are expected (1) to decide what lines of improvement in current agriculture are most needed and to discover ways of making such improvements and (2) to carry to the cultivator such recommendations as may give effect to those discoveries. Thus agricultural officers have an indirect responsibility to prevent research from becoming detached from practice and so causing waste of energy in unnecessary digressions.

A skilled chemist and agronomist may consider it quite safe to recommend improvements, fully aware that they may fail in one case out of twenty; but the district worker, directly in contact with the cultivator, must not fail even in a single instance though he is usually overworked and harassed, and sometimes entirely untrained, unskilled and unpractised. His achievements alone provide material to meet the incessant demand of critics for an estimate of the benefit derived by the cultivators through the efforts of the department.

Scientific examination of each particular enquiry even if possible can never be rapid. The district worker is seldom able to assess the possible practical value of results obtained

within the restricted boundaries of research, howsoever widely scattered the trials may be, so as to use them for his advisory work. The guides that serve him well are:—(1) the experience of local cultivators on their crops in general; (2) particular information secured from the cultivator he serves, about treatments and responses on a particular field; (3) his personal acquaintance with the problems and (4) information about the cultivator's practices, main problems and financial conditions.

If the findings of research workers, about the response or otherwise of soil types for varieties of crops or treatments, can be handed to the district worker in a usable though empirical manner which could be easily understood by both the cultivator and himself, his task will be simpler and more useful. Even progressive countries like the United States of America have felt the need of providing to their district workers a more thorough training in certain phases of soil physics, in the principles of soil chemistry and in soil mapping or the basis for soil type classifications, a little geology of soils and of soil biology and the influences these factors have upon plant growth and crop production (Ernest Van-Alstine, 1935). Fortunately for India, such elaborate training is not necessary because both the cultivator and the district worker are already well acquainted with similer information carefully collected by generations of Settlement Officers for revenue purposes. The lack of proper appreciation of this fact by research workers has left this valuable treasure practically unexploited and this is partly responsible for the failure of research to modify the cultivator's current practices. Productivity as estimated at the time of survey, is the main basis of revenue classification of lands. It is estimated from a consideration of various factors. These will be perhaps best illustrated with the help of typical examples collected from among the survey records of a few States in Central India, Bundelkhand and Rajputana, namely Alwar, Datia, Jodhpur and Narsinghgarh.

(1) The soil are first classified according to their texture, a well-known fundamental factor which determines the suitability of soils for particular crops, as shown in the following table: –

TABLE I.

Classification of soils in the four States and the local names.

Type of soil.	Corresponding local names in			
	Alwar.	Datia.	Jodhpur.	Narsingh-garh.
I Stiff clay ..	Chiknot ..	Mar ..	..	Kali ..
II Clay loam ..	Matyar I .	Kabar .	Kachar A	Bhumar I
III Sandy loam ..	,, II	Padua ..	Kachar 1	,, II
IV Poor sandy or eroded clay soils (1)	Bhur I ..	Rankar 1	Kachar 2	Patlon ..
Do. (2)	,, II ..	Rankar 2	Kachar 3	Badli ..

(2) The suitability or otherwise and the yielding power is confirmed by actual field observations and estimates, as shown in the following tables.

TABLE II.

Showing suitability of the local soils to different crops. (Datia.)

Local name of the soil	Description of the soil.	Suitable for			Remarks.
		Kharif	Rabi	Others	
(1) Gohan	Various ..	Yes ..	Yes .	..	Near villages, well manured.
(2) Mar .	Stiff clay	No ..	Yes .	..	Needs no manure.
(3) Kabar	Clay loam	More ..	Less ..	..	Needs manure.

TABLE II.—(*Continued.*)

Local Name of the soil.	Description of the soil.	Suitable for Kharif	Rabi	Others	Remarks.
(4) Padua	Sandy loam	Cotton, patwa	Gram, barley.	Sugarcane, tobacco	Requires manuring and irrigation.
(5) Rankar	Poor; sandy	Jowar, Bajra, Til, etc	No.	..	Three years under fallow after two consecutive harvests.
(6) Tir ..	Silt ..	..	Barley, Gram, Tobacco	..	Flooded by rivers during rains.
(7) Kondar	Sandy loam	..	Yes ..	..	..
(8) Khadar	Do. ..	..	Tobacco, Sarson, Wheat	..	Flooded by rivers during rains.
(9) Kachar	Do. ..	Ground-nut.	..	Chillies, Potatoes	Rich soil away from rivers.

TABLE III

Showing crop-producing power of the soils in Alwar State. Yields in mds. per acre.

Crops.	Chiknot.	Matyar.	Bhur I.	Bhur II.	Chahi*
Barani Kharif—					
(1) Cotton ..	5·6	4·0	3·2	3·2	8·0
(2) Jowar ..	7 2	6 4	5 6	3·6	12 8
(3) Maize ..	8 0	5·6	4·8	..	16·0
(4) Bajra ..	7·2	6·4	5·6	3·6	11·2
Rabi—					
(1) Wheat ..	8·0	7·2	6·4	4·6	16·0
(2) Barley ..	9·6	8·0	4·8	3·2	22·4
(3) Gram ..	6 4	6·4	4·8	3·2	12·8
Irrigated—					
(1) Sugarcane (local variety Ratoon also.	500	500	..	..	..

**Chahi* lands are those which are intensively cultivated with copious irrigation and well manured. Any type of soil becomes Chahi under these conditions.

The changes in productivity due to long continued manuring, special facilities for water supply (natural or artificial), degree of erosion or deposition of silt due to topographical features or vicinity to stream is also taken into consideration. All these factors, however, are known to introduce specific changes in the nature of the soil profile. This is indicated in the following table.

TABLE IV.

Classification of soils modified by different factors. Datia, Narsinghgarh and Alwar.

Modified by	Local name of the soil in		
	Datia.	Narsingh-garh.	Alwar.
(1) Proximity of village	Gohan ..	Geyda Bada	Barah.
(2) Vicinity of a river or stream		..	..
(i) Near	Tir and Khadar		
(ii) Distant	Kachar		
(3) Topographs:—			
(i) Plains, ...	Mar ..	Choras ..	Chiknot
(ii) Between low-lying and elevated	Kabar ..	Dal .	Matyar.
(iii) Rocky and hilly tracts ..	Rankar	Badli ..	Bhur.
(iv) Low-lying	..	Philan, Saman.	Khatile.
(4) Special water-supply:—			
(i) Artificial	..	Adhan ..	Chahi (mojuda).
(ii) Natural		..	Dehri.
(iii) In previous years ..	..	Fardia ..	Chahi (sabiqua) and Dehri (sabiqua).
(5) Deterioration due to weed growth.	..	Kanada ..	..
(6) Proximity to jungle	..	Jungle .	..

Sometimes economic factors, *e.g.* vicinity to towns or markets or infestation by wild animals, force some soils to be classed in another group because the revenue rates follow the names of survey classes. This affects only a small part of the tract and can always be easily found by local enquiry, and by observations on the vegetation characteristics of such soil classes.

TABLE V.

Typical common vegetation and the soils growing it. (Alwar, Datia and Jodhpur.)

Vegetation.		Type of soil.	Corresponding soils in.		
Local name.	Latin name.		Alwar.	Datia.	Jodhpur.
(1) Dhao..	Amogeissus pendula.	Light and poor soil.	..	Rankar and Padua	..
(2) Babul	Acacia-Arabica.	Heavy rich	Chiknot	Kabar and Mar.	..
(3) Karil .	Capparis aphyila.	Sandy ..	Matyar II and Bhur	Padua and Rankar.	All the soils.
(4) Shisham	Dalbergia sissoo	Heavy but open.	Chiknot	Kabar ..	..
(5) Pulash	Butea frondosa.	Poor clay soils.	Chiknot Matyar I.	Kabar .	Kachar A.
(6) Karonda.	Carissa caranda.	Do.	Do.	Do. ..	Do.
(7) Ber ..	Zizyphus sp.	Light soils and eroded heavy soils.	Bhur and Matyar II.	Do. ..	Do.

It is surprising to see how much valuable information on soil ecology exists in the survey records. In these records much information exists about the type of parent rock, its depth, degree of decomposition in its upper layers, the

nature and existence of concretions, fragmental materials or sometimes animal residues such as shells of molluscs in different soil depths, and the movement of the water table in different seasons. This may easily be illustrated by a few examples given below:—

The existence of rock at $1\frac{1}{2}$' to 2' depth in *clamat* soil of Narsinghgarh and the mention of how fertility differences are connected with hard and soft rock fragments in Datia, the existence of white concretions in *Kabar* and shells in *Nar* soils of Datia and the information regarding the movements of water-table (ranging from 1 foot to 7 feet) in the soils of Datia are examples. Numerous others of this type can be cited and it is needless to emphasise their value to the soil scientist.

It is interesting to find how similar soil types can exist in areas having similar parent rocks, but different climatic conditions, *e.g.* Bundelkhand and Rajputana. This seems to have been brought about by the interaction on the rock-material of the temperature and hydrological conditions, resulting in similar degrees of weathering and transport. The presence of *Kabar* soils on level land in Bundelkhand and of *Chiknot* soils in the narrow valleys at the base of very steep hills in Alwar, that of *Padua* soils in the upper slopes in Bundelkhand and of *Bhur* soils at Alwar may be cited as examples, all of them being derived from gneissic, schistose and allied rocks. The differences due to parent-rock can be seen by comparison of the derivatives of traps and other rocks, other conditions being equal, *e.g. Chiknot* from Schist) in Alwar and the black cotton soil (from basalt trap) of Nimar, *Padua* (from Bundelkhand gneiss) in Datia and *Bhumar* (from shales) in Narsinghgarh.

It should be clear from this how a study of the affinities or otherwise of the several survey names of soils in different tracts will enable the research worker to regulate the lines of his investigations and translate his results into a form easily understood by those whom he expects to profit by them. Reports of field experiments ought, therefore, to state clearly the applicability of the results to the appropriate

settlement classes so as to indicate the range of their extension in practice.

For the student of soil science in general, the revenue classifications when examined in this manner may make it easy to select quickly without the least uncertainty typical units in any tract for closer investigation. A considerable portion of the elaborate and costly work usually needed in the survey of untouched areas will thus be eliminated, resulting in a great saving of time, energy and money. It would be interesting to connect exectly, if possible, the Settlement groups of soils with scientific classifications.

Acknowledgments.—The authors are much indebted to the Revenue department in Alwar, Datia and Narsinghgarh for placing information so freely at their disposal and in particular to Rai Sahib Lala Ramlal Anand, Revenue Minister, Alwar. Mr. T. R. Khosla, Director of Land Records, Datia, and Rai Sahib L. Raghubar Dayal, Revenue Officer, Narsinghgarh, without such co-operation this paper could not have been written. Most of the Jodhpur data has been derived from the Final Report on the Settlement Operations of the Khalsa villages in the Marwar State, 1921-26 by D. L. Drake-Brockman, printed in 1930.

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(3) Owens, J. S. (1935). The interdependence of agronomic research and resident and extension teaching. Ibid p. 413.

ONE METHOD OF CONTROLLING MOSQUITOES IN AMERICA

Dust all mosquito-breeding waters with Paris green diluted with soap-stone, so that only half a pound of the poisonous green powder is spread per acre of water treated.

YIELDING CAPACITY OF PADDY*

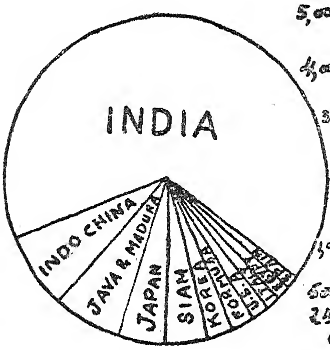
By

S. Razi Haidar Naqvi, B. Sc. (Agri).

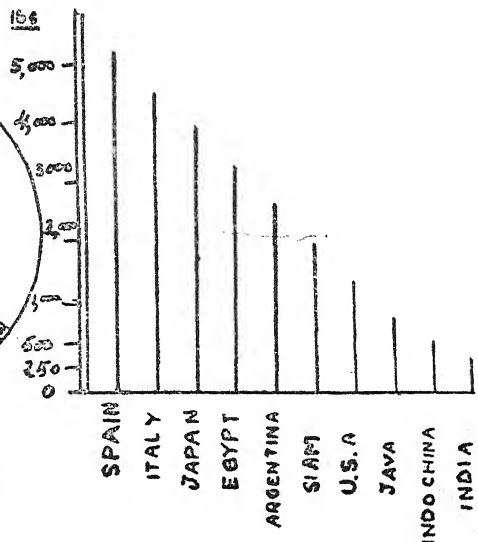
Senior Research Assistant, Rice Research Section, Sabour.

It is well known to all those who have any connection with Agriculture that the area under rice in this country is much more than in any of the other rice producing countries of the world except China for which no statistics are available. The comparative area under paddy in the different paddy growing centres of the world and their average production is indicated below :—

Comparative area under rice in different rice growing tracts of the world.



Yield of rice per acre in the more important rice growing countries.



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Naturally the question arises as to why India cuts such a sorry figure, in so far as yielding capacity is concerned,

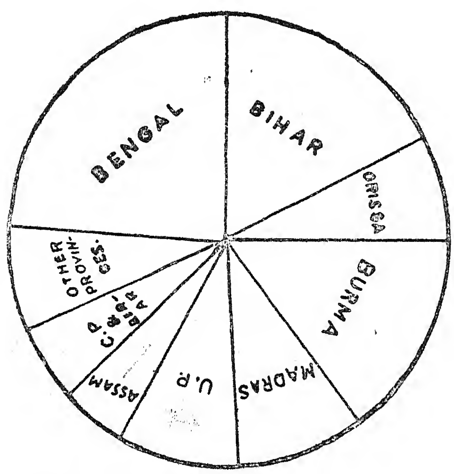
N.B. *Translated and reproduced from Hind Kisan Vol. 7, Part 7, October 1939.

especially when paddy occupies the first place among all the cultivated crops in India as is evident from the statement given below :—

Food Crops.			Non-food Crops.		
1	Rice	80·2 Million Acres.	1	Cotton	18·2 Million Acres.
2	Wheat	24 0 ,, ,,	2	Fodder Crops	8·9 ,, ,,
3	Juar	20·5 ,, ,,	3	Sesamum	3·4 ,, ,,
4	Gram	14·3 ,, ,,	4	Rape and Mistard	3·1 ,, ,,
5	Bajra	12·3 ,, ,,	5	Jute	2·8 ,, ,,
6	Barley	6·6 ,, ,,	6	Linseed	2·5 ,, ,,
7	Maize	5·5 ,, ,,	7	Other non-food Crops	11·0 ,, ,,
8	Fruits and vegetables	5·2 ,, ,,			
9	Ragi	3·9 ,, ,,			
10	Sugar-cane	2·6 ,, ,,			
11	Other food crops	31·2 ,, ,,			

Bihar is the second province in so far as acreage in paddy is concerned and has some 12 million acres (11,980,300 acres) under it. It produces about $\frac{1}{7}$th of the total Indian rice. The comparative area under paddy in different provinces in India is indicated in the following diagram :—

Comparative area under rice in different provinces.



Copied with kind permission of the Rice Specialist, from charts kept in the Rice Research Section, Sabour.

It goes without saying that the conditions in some of the foreign countries are very different to those in India. There, they have been working patiently for the past 40—50 years and are now reaping the benefits of those researches by applying them to practical use, whereas we are still in its earlier stages and must work in the same spirit and for years to come before we could look forward to reach anywhere near

them. Before doing this, it is however necessary to look into the causes of low yield in paddy and the scope of increasing its yielding capacity to a much higher level.

The main causes for low yield could easily be classified into 4 groups :—

(1) Diversity in soil conditions.

(2) Vagaries of season and want of irrigation facilities.

(3) Use of mixed varieties and unselected grains.

(4) Ravages from insects and diseases.

(i) *Diversity in soil conditions*:—The heavy Gangetic soil of Patna and Gaya, infertile hilly soils of Hazaribagh, hard tenacious clay in the lower area of Manbhum, loose gravelly soils of Palamau and other uplands and ferruginous clay of low lands of Chota Nagpore and sandy loam of Purnea and other adjoining tracts are some of the instances of diverse types of soil in Bihar. Tirhut Division alone is composed of light loam, calcareous loam and yellowish clay. The earthquake of 1934 has again turned most of the North Bihar soils into sandy tracts.

Extensive work which has been carried out by the Rice Research Section, Sabour, with a view to evolve high yielding varieties suited to different tracts of the province clearly indicates that the same varieties of paddy do not give the same yield under different types of soil unless they are of exceptional merits and possess a high degree of adaptability. Hence definite types suited to high and low lands, sandy and clayey tracts, etc., have to be carefully isolated and in case such work on the improvement of paddy is continued on a permanent basis, our future is destined to be bright and there seems to be no reason why in course of time we should not stand on the same footing as Spain does today.

Although saline tracts are very common in Orissa, but patches of saline areas are also to be found here and there in Bihar as well. These patches, though of no importance in themselves, add much to the total paddy produced in Bihar. After several years of investigations, specially for

Orissa, we have now reached a stage when ordinary paddy varieties, if sown, after certain simple seed treatments they give 40—50% higher yields over the untreated ones.

(2) *Vagaries of season and want of irrigation facilities:*—Nearly the whole of Purnea and about 50% of North Bihar is "Diara" or a flooded area, while most of Chota Nagpore and parts of Shahabad, Gaya and Patna suffer from drought conditions. The following figures indicate the rainfall in different parts of the province:—

1. Purnea ... ... 60″ – 69″
2. Ranchi, Singhbhum ... 55″ – 60″
3. Santal Parganas, Hazaribagh, Manbhum and Bhagalpur... 50″ – 55″
4. Shahabad, Gaya and Patna ... 42″ – 45″

Both the drainage system in the flooded areas and irrigation facilities in drought areas in particular and other paddy-growing localities in general need the assistance of the State. The Government had long felt the necessity of providing watering facilities and has already taken steps in giving effect to a very comprehensive scheme of irrigation which in due course will show its beneficial effects and the vast areas which suffer from want of water and thereby produce crops much below the average will give normal crop. It is well known to all the agriculturists that the flooded tracts on the one hand and the drought areas on the other did never produce a normal crop with ordinary paddy varieties and hence in the absence of the above-mentioned drainage and irrigation facilities, experiments carried out at Sabour under artificial flooded and drought conditions have resulted in evolving distinct varieties of paddy which are capable of standing even complete submergence under water for 10—15 days and others which are able to withstand drought conditions for a sufficiently long periods. The following are some of the flood and drought varieties:—

(*a*) *Flood varieties:*—

Kalaphulia, Ranikalma, L113; 53; V.L. 66.

(*b*) *Drought varieties* :—

(*i*) Early 46; 64.

(*ii*) Medium 21; 103.

(3) *Use of mixed varieties and unselected grains:—* Some cows as a race are high yielders while others give poorer quantities of milk. It is quite evident therefore that different breeds of cattle possess different qualities. Similar is the case with crops. And in paddy itself, we find certain varieties that are susceptible to disease and are attacked by insects while others prove to be quite immune to all such calamities. And whereas some are fine, others are coarse, or some are high yielding and others of a mediocre type. A mixed sample of paddy is composed of grains of different qualities and as such in a crop raised from this sort of seed, some plants show one defect while others exhibit some other signs of disease, etc., besides being a mixture of various sizes of grains. It is, therefore, quite evident that by sowing such seeds one cannot expect to harvest a good crop and hence the selection of proper varieties becomes essential. It must, therefore, be understood that seed (specially in the case of paddy which loses the power of germination after one year) constitutes the main point on which depends its high yielding capacity. Hence only ideal strains of seed either purchased from Government Farms and reliable dealers or raised in one's own land under congenial conditions must be sown. But unfortunately lack of up-to-date knowledge and poor means of communication keep specially the cultivators of interior villages absolutely in the dark about modern advancement in the evolution and selection of better and hardier strains of paddy. They perhaps have a little knowledge that the present Rice Research Organization has successfully made a complete agricultural and botanical survey of all the paddy varieties of Bihar and Orissa and after patient and careful studies has found out high yielding varieties possessing such desirable characters as white grains, non-lodging, immune to diseases besides being gifted with high adaptability to different soil and climatic conditions which is a rare quality. A number of our selections from South Bihar paddies have established their superiority and have yielded 20 – 50°/₀ more than the present recommended varieties of the same class (e.g. Dahia, Kanke II and Latisal). A few of these selections which were tried in different tracts of

the province and are found to do well under those conditions as well are mentioned below:—

1. *Early* :—115 BK; 164—17; 63c-18; 144.

2. *Medium* :—16 BK; 150—1; 88 BK.

3. *Late* :—51 BK; 76 BK; 474; 498; 548; 743; 98 BK.

4. *Very Late* :—36 BK; 111 BK; 877.

If pure seeds of only these superior strains are grown by every cultivator, he is sure to be benefitted enormously and get much better produce than what he is getting by growing the mixed varieties.

4. *Ravages from insects and diseases*:—Knowledge of control measures of both insects and diseases demands the most careful consideration of paddy cultivators at the present time when the various parts of India are relatively brought together through easy means of transportation. The actual ravages, due to infestation of pests and diseases, if interpreted in terms of money for the whole of the country, would be too alarming as every crop sooner or later has to pay a toll in the form of decreased products or in cases of severe infestation in its total failure.

Most important of all, in the avoidance of conditions favourable to disease, is the maintenance of vigour by means of proper cultivation, irrigation and manuring. It is the rundown field which is most likely to be attacked by pests.

Measures for controlling insect pests may be divided into mechanical, *e.g.* hand picking or bagging; and chemical, *i.e.* the use of poisons, *e.g.* contact insecticides, stomach poisons and gasses. The detailed information, being beyond the scope of this introductory article, may be given as a separate article at a later stage.

Besides the main factors responsible for low yield of paddy in the country, as dealt with in previous pages it may also be mentioned that at times lack of knowledge on the part of cultivators about the cultural and manurial requirements of the crop also leads to poor yield and the investi-

gations carried out at the Rice Research Station, Sabour, have established that with slight modifications in the present cultural practices economy in labour as well as cost, combined with better yield could easily be effected. These may be summarised below :—

1. Transplanting 4—6 week old seedlings 9" apart with earlier planting and 6" with late planting and with only 2—3 seedlings put in each hole as against the present practice of putting a bunch results in much better yield and less cost on planting and seed, etc.

2. Once the transplanted crop has been fully established, no standing water should be kept in the fields, but they should only be kept moist and at times, the soil may even be allowed to crack. This also leads to better growth and yield of the crop.

3. Manuring our paddy crop with green manures like Dhaincha whose seed (10 seers) barely cost Re. 1 per acre and if possible a top dressing of 'superphos double,' which again is the cheapest among the artificial manures (costing Rs. 5 per md.) at the rate of 20 seers per acre. This has been found to double the ordinary field and give a net extra profit of Rs. 15 per acre, after deducting the cost of manures and over and above the yields obtained from the unmanured crop.

WANTED

OLD COPIES OF THE ALLAHABAD FARMER

We are in need of several copies of the January, March, May, and July, 1940, issues of The Allahabad Farmer. The Business Manager of The Farmer will pay 12 annas a copy for any of the above issues—*Editor.*

'But it is from the tillers of the soil that spring the best citizens, the staunchest soldiers ; and theirs are the enduring rewards which are most grateful and least envied. Such as devote themselves to that pursuit are least of all men given to evil counsels.' Cato (B.C. 234-149).

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES.

For October, 1940.

I—Season.—With the exception of light showers particularly in the third week, at some places the whole month of October, 1940, remained rainless.

II—Agricultural Operations.—Agricultural operations are generally up to date. Harvesting of *kharif*, preparation of land for and sowing of *rabi*, picking of cotton are in progress.

III—Standing Crops, and IV—Prospects of the Harvest.—The condition of the standing crops is generally satisfactory and the prospects are favourable. The outturn of cotton crop is estimated at about 13 annas in the rupee.

V—Damage to Crops.—No serious damage to crops is reported, but scarcity of rain is still reported from some districts.

VI—Agricultural Stock.—The condition of agricultural stock is satisfactory. Cattle mortality is on the decline as the following figures furnished by the Director of Veterinary Services, United Provinces, indicate:

Diseases	September, 1940		October, 1940	
	Affected	Death	Affected	Death
Rinderpest	2,288	1,383	1,778	992
Foot and mouth	8,184	65	5,851	52
Hæmorrhagic Septicæmia	2,908	2,057	780	602

VII—Pasturage and Fodder.—Pasturage and fodder are reported to be sufficient everywhere.

VIII—Trade and Prices.—Prices of the chief food grains, *e.g.* wheat, barley and gram have slightly risen, while that of rice and *arhar dal* have fallen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month :

	End of September, 1940	End of October, 1940
Wheat	3·705	3·734
Barley	2·762	2·766
Gram	3·418	3·429
Rice	5·112	5·082
Arhar dal	4·277	4·261

IX—Health and Labour in Rural Areas.—Adequate employment is reported to be available for the agricultural and labouring classes. Cholera is still reported from some districts.

For November, 1940.

I—Season.—There was practically no rain during the month of November, 1940.

II—Agricultural Operations.—Agricultural operations are well forward. Sowing and irrigation of *rabi*, harvesting of *kharif*, picking of cotton and crushing of sugarcane are in progress.

III—Standing Crops and IV—Prospects of the Harvests.—The condition of the standing crops in generally satisfactory and the prospects are favourable but rain is needed at places.

V—Damage to Crops.—No serious damage by locusts or other calamity is reported. Swarms of locusts have been seen in some districts but the damage done has been slight.

VI—Agricultural Stock.—The condition of agricultural stock is satisfactory. Cattle mortality is further on the decline as may be seen from the following figures furnished by the Director of Veterinary Services, United Provinces :

Diseases	October, 1940		November, 1940	
	Affected	Death	Affected	Death
Rinderpest	1,778	922	1,752	873
Foot and mouth	5,851	52	6,210	29
Hæmorrhagic Septicæmia	780	602	147	118

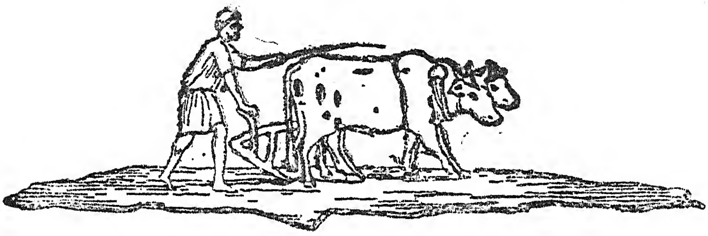
VII—Pasturage and Fodder.— Pasturage and fodder are reported to be sufficient everywhere except in the Aligarh district where scarcity of fodder is reported.

VIII—Trade and Prices.—Prices of the chief food grains like wheat and rice have slightly risen while those of barley, gram and *arhar dal* have fallen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month :

	End of October, 1940	End of November, 1940
Wheat	3·734	3·866
Barley	2·766	2·764
Gram	3·429	3·421
Rice	5·082	5·118
Arhar dal	4·261	4·202

IX—Health and Labour in Rural Areas.—Adequate employment is reported to be available for the agricultural and labouring classes. Stray cases of cholera and outbreak of fire are reported from some districts.

THE
ALLAHABAD FARMER



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Editorial

Developing Indian Agriculture

In the early days of the British Government in this country and even before the administration of India was transferred to the British Crown, the policy with regard to the agriculture of this country was to encourage the growth of those crops needed for export, more especially for the United Kingdom. Thus the East India Company encouraged the growing of such crops as sugar cane and cotton in order to meet the "home" demand. A more definite agricultural policy was mooted during the viceroyalty of Lord Mayo, when the creation of an agricultural department was considered. When in 1880 the Agricultural Department was created, or rather re-created as it was really first established in 1870 as a department of Agriculture with Revenue and Commerce,—one of the main objects of the department was to increase the food supply of the country. This object was brought to the forefront mainly as a result of recommendations of the Bengal

and Orissa Famine Commission of the time of Lord Lawrence and of another Famine Commission of 1880.

During the viceroyalty of Lord Curzon, agricultural departments and agricultural colleges were started in various provinces with the idea that research might be steadily applied to agricultural problems. This view was probably the upshot of the findings and report of Dr. Voelcker, who came out to India to investigate the agricultural conditions of the country. This further led to the establishment of an Agricultural Research Institute at Pusa, and later the sugar cane breeding station at Coimbatore, the Institute of Plant Industry at Indore, the Technological Research Laboratory at Bombay, and the Imperial Institute of Sugar Technology at Cawnpore.

With a view to co-ordinate the work of agricultural research in this country and as a result of the recommendations of the Royal Commission on Agriculture of 1926, of which Lord Linlithgow was the Chairman, a committee now known as the Imperial Council of Agricultural Research was created. This body, in the few years of its life, has greatly stimulated the development of agriculture in this country.

One of the far-reaching recommendations of the governing body of that committee in their recent meeting is the setting up of sub-committees for each important commodity. We have no hesitation in saying that such committees should be set up in the provinces also, as we believe that the exploitation of every important commodity is an urgent need of the country. The exploitation of agricultural resources should, in our opinion, govern the future policies of agricultural departments in this country.

In order to make our meaning clear, we shall illustrate by taking such a crop as rice. The development of this important crop in this country should include not only the study of the botany, genetics, and agronomy of the rice plant, but should also include the study of its utility, and of all the possible products and by-products, the marketing of rice, and all the problems connected with it. Such work

on each crop should be so co-ordinated that one line of study should have a useful relation to another.

For instance, just look at what other countries are doing, say with such a seemingly unimportant crop as the peanut which we can so easily grow in this country. Besides the oil which is extracted from peanuts and which is made use of for all kinds of purposes, peanut or groundnut cake is used in America as a fertilizer; the vegetative parts are used as food for cattle, and the peanut is itself used for peanut coffee, peanut butter, peanut this and peanut that. And we know that the limits to which the products of the soybean plant may be used have not been reached yet in other countries. This lowly crop has recently claimed a position in the national economy of the United States well beyond that which might have been expected even a few years ago by persons familiar with the wide range of uses of this crop. Soybean products now include paints, varnishes, oil cloths, water proof goods, soaps, linoleums, cooking oils, salad oils, printers' inks, etc., etc.

When this country can grow as good maze as any part of the United States, we do not understand why corn flakes and breakfast foods of all kinds should be imported from America and other countries of the world where labour is ten to fifteen times more expensive than it is in this country.

India abounds in agricultural resources of all kinds, and we hope that the next few years will see systematic planning for exploiting all the agricultural resources of this country.

Mechanization is the development and improvement of tools and the utilization of non-human energy to provide for the needs and wants of man.

The Standard of Living of the Indian Cultivator cannot be appreciably raised without Mechanization of Agriculture.

MASON VAUGH.

SEEDS AND SEEDING

S. Chowdhury, B.Sc. Agri., Assoc. I. A. R. I.

Field crops are propagated chiefly by means of seeds, rather than by means of cuttings or other special parts. Moreover the seeds propagation is of the easiest and simplest kind, adaptable to wholesale methods. There is no necessity for the employing of grafting or other special practices.

A very few of the field crops are propagated by a sexual parts or cuttings of them, as potato, sweet-potato, sugar-cane, cassava. Wherever cutting propagated plants are raised from seeds, the seedlings are likely to vary greatly, so greatly, in fact, that seed propagation may be employed with such plants for the purpose of securing new varieties.

Quality in Seeds.—The merits of good agricultural seeds lie in the following characteristics :—

(1) They are 'strong' or able to produce vigorous normal plants.

(2) They are free of disease.

(3) They are of proper variety or strain.

(4) The sample carries no impurities or adulterations.

Whether seeds are 'strong' depends in part on the vigour or strength of the plants that produced them, in part on their age, in part on the way in which they were grown, and in part on the way in which they have been handled and kept. Tables of longevity—that is, of the number of years that seeds retain their germinating power—are of some value in determining whether seeds of a given age are likely to be good. Such a table compiled from various sources is given below. This table present only averages, however, and is likely to be of more use as information than as advice. Many conditions influence the longevity of a seed. When well ripened and kept in a dry cool aerated storehouse, the viability may be retained longer for some seeds than the

figures indicate. The table usually represents extreme average longevity. The vigour of the seed as expressed in crop-producing power, may decline long before it ceases to retain life. Fresh seed is, therefore, safest; although certain seeds of the melon family are said to produce better crops when a year old.

LONGEVITY OF CERTAIN SEEDS

	Average years.	Extreme years.
Barely	3	
Bean	3	8
Beets	6	10
Buckwheat	2	
Cabbage	5	10
Carrot (with the spines)	4 or 5	10*
Carrot (without the spines)	4 or 5	10*
Chiroy	8	10*
Clover	3	
Flax	2	
Gram	3	8
Hop	2	4
Lentil	4	9
Maize	2	4
Millet	2	
Mustard	3	10
Oats	3	
Parsnip	2	4
Peas	3	8
Pumpkin	5	9
Rape	5	
Soybean	2	6
Squash	6	10*
Turnip	5	10*
Wheat	2	7*

*The asterisk denotes that the seeds had not all lost their germinating power at the termination of the number of years recorded.

The term *purity* denotes freedom from foreign matter, such as chaff, dirt, or seeds of other plants, but it has no reference to the genuineness of the variety, which is called by seedsmen *purity of stock*. The percentage of *germination* is reckoned by count from a sample freed from foreign matter, a seed being considered as having germinated when the root-let or radicle, has pushed through the seed coat. It is not to be understood that the real value of a quantity of seed is dependent wholly upon the number of pure germinable seeds it contains. The ancestry of the seed and its trueness to type are factors of primary importance in determining seed value. These points, however, are very difficult, if not impossible, to determine at the time of purchase, while purity and germination are easily ascertained and are very essential points. The germinability of seeds are determined by tests conducted between moist blotters; such tests usually give a little higher result than those made in soil.

The Seed Bed.—The character of the seed bed, or the ground in which the seed is planted, has very much to do with the success of the crop. A vigorous start is a long step towards a good crop. Such a start contributes to early continuous growth, the plant has 'constitution' to withstand adverse conditions, it may be able to overcome insects or plant diseases or to recover from the attacks of them. The fit preparation of the land has for its object the making of a good seed-bed, the increasing of the pasturage for roots, the physical and chemical amelioration of the soil. If the seed germinates freely it must be in close contact with a firmly settled soil. This means that the soil must be finely broken and evenly surfaced. Many implements are now manufactured to aid in putting the finish on the seed-bed, as smoothing harrows and special forms of cultivators. After the crop is well up the seed-bed is broken up by subsequent tilling or if the crop is not tilled, as the cereal grains, the seed-bed disappears by the action of the elements and the natural settling together of the soil. The seed-bed is therefore only an epoch in the care of the field.

The comminuting tillage tools leave the ground loose or more or less open. In this loose earth the seed is readily

incorporated. But the earth may be too loose to promote the best germination. In such cases the roller is used to compact the earth. The soil grains are then settled about the seeds, and the sub-surface moisture passes up from grain to grain or through the small cavities, and supplies the seed. This moisture is on its way toward evaporation into the air, therefore it is well to break up the compact surface by tillage as soon as the plants are well established in order to prevent the further loss of moisture.

The Quantity to Sow.—The reader will want to know how much seed of the various crops is required for an acre. This information is difficult to give as we plant in hills or rows at all distances, drill at all distances, semi broadcast or broadcast at no distances, and we grow crops for a number of purposes. The table given below, therefore, represents either averages or extremes and the person who is looking for precise direction is likely not to find it, and he is told that it all depends on conditions and as likely as not he does not know what the conditions are. However a table has been compiled from good sources and the reader is referred to standard texts for further informations.

Quantity of Seed Per Acre

Alfalfa (broadcast)	20-25	lbs.
Alfalfa (drilled)	15-20	lbs.
Arhar	5-10	lbs.
Artichoke (Jerusalem-bulbs)	5	mds.
Bajra	6-10	lbs.
Barley	60-70	lbs.
Beans	1	md.
Beet	2½	srs.
Buckwheat (broadcast)	50	lbs.
Buckwheat (drilled)	12-25	lbs.
Brussels sprouts	2	ozs.
Broccoli	2	ozs.
Cabbage	4	ozs.
Carrots	8	ozs.

Carrots (for stock)	...	...	...	4-6	lbs.
Castor	...	...	...	4-6	lbs.
Celery	...	...	...	1	oz.
Chena	...	...	...	10	lbs.
Clover	...	...	...	8-15	lbs.
Cowpea	...	...	...	12	lbs.
Cotton	...	...	...	5-10	lbs.
Endive	...	...	...	1½	ozs.
Indigo	...	...	...	10-15	srs.
Ginger	...	...	...	2	mds.
Gram	...	...	...	15-50	lbs.
Groundnut	...	...	...	20	srs.
Juar (grain)	...	...	...	10	lbs.
Juar (fodder)	...	...	...	30	lbs.
Jute	...	...	...	9	lbs.
Khesari	...	...	...	12-16	lbs.
Kulthi	...	...	...	20-25	lbs.
Kalai (Urd)	...	...	...	8	lbs.
Kodo (*Paspalum*)	...	...	...	2	lbs.
Leek	...	...	...	1	oz.
Lettuce	...	...	...	3	ozs.
Linseed	...	...	..	4-6	srs.
Marua (Ragi)	...	...	...	7-10	lbs.
Mung	...	...	...	5-8	lbs.
Musuri	...	...	..	12	lbs.
Mustard	...	...	...	4-6	lbs.
Mustard (with wheat or barley)		...	...	1½	lbs.
Oats	...	...	...	50	lbs.
Opium	...	...	...	3	lbs.
Onion (sets)	...	...	...	1	md.
Onion (seeds)	...	...	...	8	ozs.
Parsley	...	...	...	2	ozs.
Potato	...	...	...	10	mds.
Parsnips	...	...	...	6	ozs.
Peas	...	...	...	1	mds.
Radish	...	...	...	8	ozs.

Rice (Transplanting)...		...	...	10	srs.
Rice (drilling)	...	...	..	20	srs.
Rice (brocasting)	...	...	...	30	srs.
Safflower ...	...	...	...	16	lbs.
Sorguja ...	...	...	...	20	srs.
Soybean ...	..	...	...	30	lbs.
Sugarcane (sets)	...	...	...	12000	
Sunnhemp	...	..	...	20	srs.
Til ...	...	..	...	8-10	srs.
Tobacco ..	...	...	...	½	ozs.
Turnips ...	..	...	...	6	ozs.
Turmeric ..	..	...	..	2	mds.
Wheat ...	...	...	...	50	lbs.

Storing of Seeds.—The first requisite to the keeping of seeds is to have them well grown, from strong and healthy parents. The second requisite is to have them well cured, or free from mould or damp. The room should be dry and devoid of great extremes in temperature. Very low temperature is less inimical than very high temperature. Moist seeds are less able to withstand extremes of temperature than dry seeds. In large quantities seeds are best stored in bags. In all cases it is well to keep the bags or boxes tied or shut to avoid currents of air and thereby avoid either too much dampness or too great drying and to exclude vermin. Peas, beans and maize are specially liable to injury by weevils when in storage. Bisulphide of carbon may be poured into the receptacle on the seeds. It quickly volatilizes and destroys all animal life if the receptacle is immediately closed tight. A tea-spoonful is sufficient for eight or ten quarts of seed in a very tight box. Carbon bisulphide is very inflammable and care should be exercised to avoid the danger of an explosion. It should never be handled freely in rooms containing fires of any kind.

Contrary to popular belief, dairy cows do not drink much more water in hot weather than in cool weather—experimenters have watched them.

(*Science News Letter, July* 39)

BUFFALO BREEDING IN THE UNITED PROVINCES

By

M. J. Zachariah, B. Sc. (Ag.)

Manager, Station Dairy, Ranikhet.

There are over fifteen million buffalo cows in India. To replace them it would be necessary to provide at least twice this number of good dual purpose cows. Hence the Royal Commission on Agriculture in India has rightly said: "The time is far off when the cow will supersede the buffalo."

In British India buffaloes provide 47·5 per cent of the total milk supply, and in India as a whole they provide nearly 45 per cent. Also in five out of the twelve provinces in India, the buffalo actually produces more than half the total milk produced. Consequently the main *ghee* producing areas of India are situated in these provinces.

Numerically in the United Provinces, the cows exceed the buffaloes, being 5,726,249 and 4,060,877 respectively. But the average lactation yield of a buffalo is greater than that of a cow, being 1000lbs. and 800 lbs. respectively.*

The Village Buffalo and its management.—Buffaloes cannot stand intense heat; they love to wallow in tanks, streams, pools and rivers. They are therefore found in large numbers in villages where rain water collects, in the canal estates, and along rivers and streams. The buffalo cow bears her first calf when she is three and a half to four years old, and produces 8 or 9 calves in all.

The villager usually prefers raising a buffalo to a cow. The main reason for this is that the buffalo can stand the

*Report on the development of the Cattle and Dairy Industries by Norman C. Wright, 1937.

coarser food-stuff of the village better than the cow. Also in contrast with the cow no special sanctity is attached to the buffalo by the villager and often unthrifty calves, as soon as they are weaned, are allowed to die a natural death from starvation. This practice, though cruel, is very good from the scientific breeding point of view and partly explains why the buffaloes are better producers of milk and butter fat. The villager does not keep records of the milk and *ghee* produced by his animal. Yet the female calves of good specimens are cared for better and there is a good demand in the village for such calves.

The quality of the indigenous breed.—The best indigenous breed of buffaloes in U. P. is the "Badavan." It is found in the neighbouring districts of Agra and Etah. They are fairly good sized animals with characteristic horns. Some animals of this breed have produced up to fourteen pounds of milk per day. No other indigenous breed is found in this province which is worth mentioning.

High quality of the Murrah breed.—The Government cattle breeding farms at Bharari in Jhansi, and Madurikund in Muttra, have herds of the "Murrah" or Delhi breed of buffalo. The home of this breed is the southern Punjab and Delhi Province, but it is extensively bred in a wide area, even extending to the northern United Provinces.

A "Murrah" buffalo cow has a very deep massive frame, with a comparatively light neck and head; short tightly curved horns, a well developed udder, and a long tail reaching the fetlock. The colour is jet black with white marking on the tail.

This breed of buffalo is at present probably the most efficient milk and butterfat producer among Indian cattle. On Government farms it is aimed to have selective and controlled breeding of this breed for milk production and conformation. The average lactation yield of this breed is between 2500 to 3500lbs. Some high class animals yield over 7000 lbs. in a lactation.

Recently the Government have started a systematised form of breeding of this breed in the districts of Muttra,

Agra, Mainpuri and Etawah. Here a scheme of registration of buffalo cows and their progeny has been started. Bulls raised at the two Government farms are distributed to these districts to grade up the indigenous breed. By this method eventually these districts will be breeding areas for this breed, and it is expected bulls raised in this area will be of such a high grade that they can be issued to other districts to grade up the animals there.

Allahabad Agricultural Institute.—Besides the Government farms, scientific and systematised breeding of this buffalo is carried on at the Allahabad Agricultural Institute under well qualified experts. The policy adopted is one of grading. Bull calves from the best buffaloes of the Institute as well as bull calves from the best buffaloes of the neighbouring Military Dairies are purchased and raised. Out of these, approved bulls are given out to people who are willing to co-operate with the Institute in the neighbouring villages and also at the milking stations of the department of animal-husbandry and dairying. At the milking stations the milk yield of individual animals is recorded with a view to evaluate the dam daughter difference to govern the future allotment of bulls in the grading up policy.

Military Dairies and Government Institutions.—The Military Dairies of Lucknow, Allahabad and Cawnpore, have herds of "Murrah" buffaloes. Some of the best milk producers of this breed are found in these herds.

Specimens of this breed are also kept at the Provincial Agricultural College, Cawnpore, and at the Agricultural School, Bulandshahr.

Import of buffaloes.—A large number of these buffaloes are imported to this province from the Punjab. There are professional dealers who import these animals and carry on a flourishing trade throughout the year.

Conclusion.—It is certain that for many years to come the buffalo will stand high in competition in milk and butter fat production in the villages. Therefore every effort should be made to improve its productiveness and constitution.

DRYING OF FRUITS AND VEGETABLES

By

Md. Hamza Hashmi, B. Sc. (Ag.)

The present international crisis and the world war must be an eye-opener to every individual who is engaged in the fruit and vegetable preservation industry. In the year 1898 Germany had only 3 factories for the drying of fruits and vegetables, whereas the number rose to 1900 in 1917, showing thereby the ability of the German people to maintain their food supplies during the war. It is therefore wise for India to wake up and make hay while the sun shines, and follow the example of America by dehydrating or sun drying enormous quantities of fruits and vegetables and shipping the same to the allied armies in Europe and other parts of the world.

The term "Dried" is applied to all dried products regardless of the method of drying. Generally speaking, there are two ways of drying:— 1. Sun drying (nature's way) and 2. Dehydration (the artificial method). In technical language, "Dehydration" is drying by artificially produced heat under carefully controlled conditions of temperatures, humidity and air flow. The advantages of dried products are the following:—

1. Dried foods are in a more concentrated form than foods preserved otherwise.

2. They are less costly to produce than canned or preserved food as the cost of labour is reduced and no sugar is required.

3. There is a very considerable reduction in bulk, as the dried product is only 1/4th to 1/9th of the fresh material. Accordingly, dried fruit requires less storage space and smaller number of tin and boxes than an equivalent amount of fruit in the canned or preserved form. The cost of transportation is also reduced.

Sun Drying.—The simplest way of preserving fruits and vegetables is by drying them in the sun, and this is commonly used in the case of plums, peaches and apricots in the West. Plums which can be dried without the removal of seeds and without fermentation are termed, "Prunes". They form an important crop in Europe and America.

Among the Indian fruits and vegetables, the mango, guava, ber (jujube), roselle, cabbage, peas and beans are the prominent ones that can be dried satisfactorily in the United Provinces.

Wherever climatic conditions permit, sun drying is the least expensive method of preserving food-stuff. Successful sun drying demands that a rainless season of bright sunshine and high temperature should coincide with the period at which the crops to be dried are maturing. Fortunately these climatic factors particularly favour the drying industry in the United Provinces. With the exception of the rainy season of July, August and September, drying conditions are excellent throughout the year.

Small quantities of fruits may be dried in the sun without making trays as the products may be spread upon clean boards, canvas, heavy wrapping paper or clean plates. For larger quantities trays will be required. They should be uniform in size for convenience in stacking. The lumber used must be as light as is consistent with durability. The most convenient sizes used are:—$2' \times 3'$, $3' \times 3'$, $3' \times 6'$ and $3' \times 8'$.

Sun drying has the following disadvantages:—

1. Sun drying in the open air allows the insects to deposit their ova (eggs) on the drying material.
2. Exposure to dust, borne by air currents is also harmful.
3. There is a loss of chlorophyl.

These factors may be controlled by following the preventive measures given below :

1. Insects may be excluded by providing the trays with covers of mosquito netting.

2. Dust can be avoided by using glass-covered solar driers. (A solar drier is essentially a ventilated box with an inclined glass top so placed that the rays of the sun fall directly upon the glass for as many hours as possible each day).

3. Dehydration reduces the loss of chlorophyl.

From the practical standpoint "sulphuring" of fruits and vegetables before drying, provides sufficient disinfection to ensure safety against the perils of the above drawbacks.

Fruits should be dried so as to leave 5 to 6% of the moisture in the end, at which stage the product must be flexible. Vegetables may be dried so as to remove 100% of the moisture, as they can be used anytime after soaking the dried vegetable in water for 24 hours. Perfectly dried vegetables should be brittle.

Dehydration.—In our country at present there seems to be little scope for dehydration, but the artificial process of drying is gaining importance day by day because of the following advantages:

1. The work is made independant of weather conditions.

2. The products retain their natural appearance and flavour to a greater degree than is possible to secure in sundrying.

3. Dehydration provides more sanitary conditions for the drying of fruits and vegetables.

4. There is more careful control over the quality of the finished product.

On the other hand dehydration has the disadvantage of requiring closer supervision and the process is more expensive, since an evaporator must be constructed or purchased and a supply of fuel provided.

A home-made drier may be devised by providing a wooden box with trays and wire netting. The presence of holes on top is essential for free circulation of steam, otherwise the humidity rises and fruit does not dry. An *angethi* charcoal burning may be conveniently used for providing heat and the

temperature regulated by inserting a thermometer in the top of the drier. In the case of most of the fruits and vegetables a temperature of 110° to 140°F. maintained for 5 to 6 hours will suffice.

A list of the important fruits and vegetables for drying in India is given below:— grape, mango (both ripe and green), guava, peaches, pear, apples, litchis (with the pericarp or the outer covering), papaya, jujube, cauliflower, cabbage, turnip, pear, beans, maize, tomato, okra or lady's finger, spinach and gram (green).

Procedure.

1. *Selection of fruits and vegetables.*—Select fruits of high quality in mid season. Do not dry late or early varieties. The rule should be straight from the orchard or garden to the drying chamber or tray after the usual preparation.

2. *Washing.*—Wash the fruits or vegetables selected in cold water.

3. *Preparation.*—With a sharp knife peel the fruit and cut it into slices, removing the stones and making the slices not too small, as the size diminishes on drying. Slices should be thin, uniform and translucent. The knife should never be rusty and the slices must be dropped in common salt solution.

4. *Blanching.*—Blanching is the treatment with hot water, steam, sodium bicarbonate or salt solution for two minutes. This process provides the following desirable features.

(*a*) It gives a thorough cleaning.

(*b*) It retains the fine clour of the vegetables.

(*c*) Any undesirable smell is expelled.

(*d*) The skin is easily peeled off.

All vegetables and some fruits, for example peaches, should be blanched in 1% sodium bicarbonate solution or 5% brine for two minutes.

5. *Chilling.*—The process of putting the fruits or vegetables in cold water immediately after blanching is termed "chilling". The objects of chilling are:

(*a*) To crack the skin (*e.g.* in tomatoes) .
(*b*) To harden the pulp.
(*c*) To set the colouring matter.

6. *Sulphuring.*—Sulphuring is exposoure to the fumes of burning sulphur inside a closed chamber, *i.e.* the drier. Sulphur dioxide fumes disinfects the material. Sulphuring should not exceed 10 minutes ordinarily, lest some flavour be lost, although in big drying factories sulphur is burned for 3 to 6 hours in the case of most fruits. Vegetables are often exposed to sulphur fumes for 30 minutes.

7. *Drying.*—The two processes of sun drying and dehydration have been discussed. Sun drying is more convenient and less expensive under Indian conditions.

8. *Storing.*—Keep the dried product in a dry place by wrapping in envelopes of wax paper or other suitable wrapper for home use. If drying has been done on a commercial scale, store the product in tins, bottles or boxes.

Use.—For cooking, soak the vegetables in water overnight and then cook in the same water to utilize the dissolved mineral salts. Use three cups of water for every cup of dried vegetable. Dried fruit can be used without any soaking.

In order to give a rough idea of the quantity of fresh fruit or vegetable required to obtain the desired weight of the dried product a table is given below.

Approximate yields of dry products per 100lbs. of fresh material.

	lbs.		lbs.
Apples	12—15	Peaches	13—16
Appricots	16—18	Pears	18—22
Beans	11—13	Peas (garden) ...	22—25
Cabbage	8— 9	Potatoes	23—25
Carrots	10—12	Pumpkins	6— 8
Cauliflower ...	12—14	Spinach	8—10
Figs	18—23	Tomatoes	$6\frac{1}{2}$— 9
Okra	10—11	Turnip	7— 8
Onions	9—11		

SOME PRINCIPLES OF GENETICS

By

James N. Warner, M. Sc.

Professor of Dairying.

Chromosomes are small thread-like structures, generally appearing in pairs, in the nucleus of the body cells or somatoplasm of animals. Located at the same respective place on each chromosome is a gene Corresponding genes constitute a pair. Each pair of genes is directly very often responsible for one physical character of the organism. The sum of all physical characteristics is known as the phenotype.

Dominant genes are those which influence the phenotype whether the companion gene is also dominant or recessive; the recessive genes are those which are able to affect the phenotype only if both paired genes are recessive. The combination of genes for all characters of an animal is known as its genotype. When two dominant or two recessive genes occur in a pair the condition is said to be homozygous for the character involved; when the genes of a pair are one dominant and one recessive the condition is termed heterozygous.

Each normal animal contains a number of germ cells or specialised somatic cells. By an intricate process involving division into two gametes, known as gametogenesis, those in the male produce sperms and those in the female produce ova. To each gamete goes one chromosome from each pair, carrying the genes located along it. This, one can easily see, reduces the number of chromosomes, and therefore the genes, in the gametes to one-half that of the somatic cells. When the male gamete or sperm meets the female gamete or ovum, at fertilization, a new individual or zygote results having the usual number of chromosomes.

There is known to exist in certain species of animals one exception to the appearance of chromosomes in pairs

This is the sex chromosome. In a fly, which is very popularly known to geneticists and which they call *Drosophila melanogaster*, the paired sex chromosomes are of unequal size in the male. In the female the sex chromosomes are equal and are identical in size to only one of those in the male. This chromosome is usually referred to as the X chromosomes, whereas the odd one is called the Y chromosome. This condition also exists in mammals, that is cows, horses, sheep, goats, etc., but is exactly reversed in poultry.

The Y chromosome may be larger than the X or it may be completely absent, with variations anywhere between these extremes. When absent an uneven number of chromosomes characterise that sex of the species (involved) in which the single X chromosome appears. In the other sex there remains a pair of identical X chromosomes giving an even number.

Sex-linked character are those which are determined by genes which appear on the sex chromosomes. Aside from the sex chromosomes all others appear in the somatoplasm as pairs of equal chromosomes lying side by side with genes for the same character located in identical positions on them. This is not always possible, however, where the two chromosomes differ in size or where one is absent.

The fundamental basis of heredity involves chromosomes, dominant or recessive genes and gametogenesis as outlined above. The animal breeder will not find all his problems so simple, however, as this explanation may indicate. The reasons for this are numerous and cannot be dealt with at this time. Some examples of what is discussed so far however, will make the science of genetics in large part understood. Examples of dominant and sex linked characters in poultry are described in a simple manner by Taylor and Lerner in Bulletin No. 626 of the California Agricultural Experiment Station, published in 1938.

The rose comb is dominant in relation to the single comb. A homozygous rose comb cock bred to a homozygous single comb hen will give only chicks with the rose comb.

All will, however, be heterozygous for rose comb, having received one gene for rose comb from the cock and one gene for single comb from the hen. If two of these heterozygous rose comb chicks are mated when mature, three out of four of their chicks will have the rose comb and one will have the single comb. Of those whose phenotype is similar to the parents, *i. e.*, rose comb, one out of three will be homozygous and two will be heterozygous for the character. The single comb chicks will be homozygous for that character. Refer again to the paragraph above where dominant and recessive genes are described.

Using C to represent rose comb and c single comb the cock would be represented by CC and the hen by cc. Both were homozygous you will recall. Remember also that each gamete contains only one member of the pair in each case. For this reason only gametes containing C can be produced by the cock and those containing c by the hen. Remember further that the zygote again contains the usual number, half of which comes from each parent. Only the genotype Cc can occur then from such a mating.

A simple graph method is used to illustrate this. The gametes of the cock are shown on top and those of the hen on the left side of our diagram. Each gamete of the cock is brought together with each gamete of the hen in the squares within the diagram.

	C	C
c	C c	C c
c	C c	C c

All chick will have the rose comb for which they are heterozygous

For the second generation chicks of our example, the following diagram will illustrate what has been said:

	C	c
C	C C	C c
c	C c	c c

Three out of four chicks will have the rose comb for which, one will be homozygous, and, two heterozygous. The fourth will be a homozygous single comb chick.

The next example which Taylor and Lerner give us is of a sex-linked character. It is the barred colour character in the feathers of the Barred Plymouth Rock. When a cock of this breed is bred to a black hen all chicks will be barred. On the other hand when a black cock is bred to a hen of the Barred Plymouth Rock breed only the male chicks will be barred in the first generation. The female chicks will all be black. The reason for this is that there are two genes for this character in the cock, but only one in the hen and the character can only show up when both genes appear in the somatoplasm. The barred character is dominant to black.

The diagram method which was used in the first example can again be used to show the genetics of this sex-linked character. For the cross of the barred cock to the black hen we have:

	B	B
b	B b	B b
–	B –	B –

All chicks will be barred.

For the cross of the black cock to the barred hen :

	b	b
B	B b	B b
-	b -	b -

Only the male chicks will be barred although heterozygous for the character. The female chicks will be black with only one gene for the character

It is hoped that the few genetic principles discussed here may be fully understood. Examples are given to make this more readily possible. The animal breeder is asked to remember three things in order properly to appreciate the possibility of variations in his stock from generation to generation. 1. The number of chromosomes varies from two pairs in the small fly, previously mentioned, to twenty four pairs in man. The actual number in cattle is a question. Some workers say 30 pairs and others 19 pairs, while still others say 17 pairs. 2. On each pair of chromosomes there are pairs of genes varying from only a few to a considerable number. 3. Each gene may or may not influence the phenotype depending upon whether its pair-mate is present or not, and if so whether it is dominant or recessive.

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THE IMPORTANCE OF THE FRUIT PRODUCTS INDUSTRY IN INDIA.

By

Kr. Birendra Narain Singh, M.Sc.,

Allahabad University.

In every civilized country, there have been systematic efforts made to preserve the fruit resources of the country, not only for use as a food material, after the fruit season is over, but also on account of the tremendous opportunity for export trade and commercial exploitation. But India though possessing such a wide range of climate and soil that there are few fruits of the temperate, sub-tropical and tropical zones, which can not be grown, (and many grow so abundantly that huge quantities of them go to waste every year), has to get part of its supply of fresh and preserved fruits from other countries. Fresh fruits preserved temporarily are imported in to India at an average of thirty lacs of rupees per year, as follows:—

Year	Value in rupees.
1931	33,66,661
1932	26,63,242
1933	32,17,543
1934	28,25,884

Canned and bottled fruits and vegetables worth eleven to twelve lacs of rupees per year are imported:—

Year		Value in rupees.
1931	...	8,35,610
1932	...	6,96,339
1933	...	9,50,102
1934	...	10,66,985
1935	...	11,02,736
1936	...	11,23,025
1937	...	10,16,393
1938	...	12,11,598

Fruit products in the form of jams and jellies are imported as follows:—

Year	...	Value in rupees.
1931	...	4,34,808
1932	...	3,86,025
1933	...	6,40,577
1934	...	6,28,948
1935	...	6,89,192
1936	...	6,74,289
1937	...	7,31,887
1938	...	6,54,847

Besides the above, preserved fruits in the form of pickles, chutneys, sauces and other condiments are annually imported as follows:—

Year	...	Value in rupees.
1931	...	4,24,941
1932	...	3,87,829
1933	...	6,27,910
1934	...	7,05,295
1935	...	6,78,835
1936	...	6,48,872
1937	...	7,19,882
1938	...	6,21,675

Although in India a few of the fruits are converted into preserves mainly in the form of pickles and chutneys, yet even these are made by methods which are crude and empirical, and until recently no scientific and systematic study of the problem has been undertaken. Perhaps on account of this fact, there does not exist any large organization in India for the manufacture of fruit preserves. Besides, it has come to the notice of the present author that a few commercial concerns, constituted to manufacture fruit products on a larger scale failed, not for want of capital, machinery or organization, but for want of accurate and scientific information about the behaviour of different Indian fruits when preserved. Therefore a systematic study was needed and consequently the author thought it advisible to undertake

this kind of investigation, particularly with a view to the most satisfactory utilization of the tremendous fruit resources in this country.

Canning of mangoes, litchies and grapes can be undertaken. Green peas, cabbages and other green vegetables can be preserved in a dried form. The wood apple, guava, karonda, roselle and banana have been found to yield pleasantly flavoured jellies; the orange, lemon, and grape can be made into good marmalade. Jams can be prepared from the apple, pear and papaya. As a matter of fact all the Indian fruits can be converted successfully into some form of preserves. But none of these products is being made on a large scale in our country, and as a result there is a tremendous waste of fruits and vegetables. Moreover, as the facts and figures given above indicate, there is a great necessity for such an organization in India. Fruit products in the form of canned and bottled fruits, jams, jellies, pickles and sauces are imported in our country at an average of about sixty lacs of rupees per year. Such a huge problem which faces us at the present time has attracted but little attention from either the Government or the public.

Let us examine the fruit gardens of some other lands, where every blade of grass is taken into account and people have made their fortunes out of fruit cultivation. The Hawaiian Islands, California and the Malay Peninsula are instances. The fruit industry there, is very prosperous. They export huge quantites of fresh and preserved fruits, to all parts of the world every year. In the course of the last few years, almost all the sixteen concerns in Malaya have rebuilt their factories according to modern designs, fitted up with up-to-date machinery. The average capacity of a factory is between 1500 and 2000 cases or about a lac of tins per day. Every factory is equipped with a semi-automatic can-making plant and makes its own cans. Peeling, coring and slicing is done by hand, employing about 200 to 300 labourers in each of the factories. In all, nearly five thousand men are engaged in Malaya in the canning industry.

Malaya is the second largest producer of canned pineapple, Hawaii taking the premier position. The export

value of the pineapples in the Hawaiian Islands amounts to about twenty crores of rupees, as compared to the export value of the Malayan Peninsula, which is about a crore and a half of rupees. Surplus fruits are bottled and canned in monstrous factories, the capacity of the smallest of them being a lac of tins per hour. Every portion of the fruit is employed to advantage. Not a single fruit can be found rotting anywhere. Every plantation, every plant and every fruit is properly kept and protected against damage from insects pests, wind and frosts. Several lacs of pineapples are canned in a day. The growing and the canning of pineapples has increased to such an extent in the Hawaiian Islands, that in a few years the annual tonnage has grown from few hundred tons to the tremendous total of over two lacs of tons of this delicious fruit. The factories are fitted with automatic peeling and coring 'Ginaca' machines, dealing with forty to sixty pineapples per minutes. Each canning unit consists of one Ginaca machine, a trimming table, a slicing and a packing table. The total length of each unit is approximately 65 feet. The two largest canneries have nineteen and twenty such units. On each side of the table fourteen to eighteen women are employed, for hand trimming one of the most carefully supervised operations. 'The Pittaluga' syruper is in general use, filling sixty to a hundred cans per minute. Nearly 1500 workers are employed in each of the larger plants. The rate at which the tin cans are manufactured in Honolulu, is about ten lacs per day. In summer hundreds of school boys and girls work in these huge factories to earn their school fees. Trades are usually under Government control and only the best fruit can be marketed. Besides giving subsidies to the fruit preserving factories the Government imparts education and training in fruit culture and preservation to the growers, so much so that the subject of fruit preservation has been included in the curriculum of the schools and university.

Compare this with the state of affairs in our country. During the harvest time, we can witness heaps of fruits, fancy or contaminated, all heaped together on the road side or in front of a shabby orchard, being exposed to the dust and sun, the unsold stock being rendered unmarketable.

During the time of epidemic, such stocks are thrown away by health officers. Then there are the 'murrabawalas' who preserve a small fraction of the fruits in earthen pots, by the old indigenous methods, their workshops humming with flies and wasps. Now whenever a customer comes they put their hands straight into the jars and retail their unwholesome products. All these crude methods of handling and preserving fruits are responsible for the heavy import of both fresh and preserved fruits into our country. Besides, there is also much scope for Indian specialities like canned mangoes, and mango preserves, jams and pickle in the foreign market, in view of the fact that they were much appreciated at the British Empire exhibition. Guava jelly has already gained a good reputation in India. Optimum conditions for making jelly of several other Indian fruits have been investigated by the present author, in the chemical laboratory of the University, which can be manufactured on a commercial scale, with a successful market, in view of the fact that the fruits are wildly grown and can be cheaply got and the jellies formed have an appealing flavour.

Fruit preserving factories on modern lines can be started with a capital of fifty to sixty thousand rupees which would be capable of canning and bottling goods worth nearly two lacs of rupees per year, yielding a net profit of twenty per cent. on the goods sold. The establishment of half a dozen such factories all over India would stop the wastage of huge quantities of surplus fruits and the drainage of enormous wealth to foreign countries. Beside, it would open a new industry for Indian capital, utilizing sugar, tin cans, glass bottles and other utensils produced by Indian factories. It would increase the growth of fruits by improved methods, and solve the problem of marketing fruits and vegetables, giving relief to cultivators and solving to a great extent the problem of unemployment. The fruit industry can also be started on a semi-commercial scale, with a nominal capital of five thousands of rupees only, producing goods worth over one hundred rupees per day which can easily be consumed in a few adjoining districts. Such works are running at certain places in India, with the result that some amount of preserved fruits in the form of pickles and chutneys are

exported from India, as the following figures indicate, which are of decreasing amounts :—

Year			Value in rupees.
1931	..	...	8,21,166.
1932	...	...	8,26,794.
1933	...	...	8,57,022.
1934	...	...	6,55,555.
1935	...	...	4,91,008.

But as already said, fresh and preserved fruits and vegetables in various forms are annually imported to our country amounting to over fifty-five lacs of rupees, follows :

			Value in rupees.
1.	Fresh fruits and vegetables	...	30,86,589.
2.	Canned and bottled fruits	...	10,58,065.
3.	Jams, jellies, pickles, sauces	...	13,64,195.
	Average total	...	55,08,849.

Thus, the necessity of establishing this industry on a much larger scale can be fully realised. Of course, the success of such enterprises will to a great extent depend on the support of the government. It is a matter of satisfaction that the central and the local governments have accepted some of the suggestions of the Royal Commission an Agriculture in India, by appointing the central marketing board and creating cold storage facilities. The Imperial Council of Agricultural Research is taking keen interest in the fruit industry. The Director of Agricuture, U. P., has aroused enthusiasm in these provinces in fruit growing through the Fruit Development Board. The U.P. Government has also spent a few thousands rupees in imparting training to some students in fruit preservation and aiding such institutions. But much yet remains to be accomplished in the development of the industry in general, and in the systematic chemical st udy of fruit preservation in particular, to meet the requirements of the home market and successful competition abroad. The establishment of Government Fruit Research stations in every province is of great importance to gain

(*Continued on page* 89)

MANURIAL EXPERIMENTS WITH TEA IN INDIA

An Abstract

The India Tea Association in a recent publication* has recorded the results of trials with cattle manure, composts, and unfermented organic waste materials on mature tea in bearing.

The results obtained do not necessarily apply to other crops, or even to young tea. It states that freshly added organic matter probably has a value of its own, and young tea is believed very frequently to provide one of these cases. Good mature tea is not thought to need any more organic matter that it receives in the form of its own prunings. The author further points out that the occasional application of five tons of humus compost per acre, which contains about half a ton of organic matter can hardly make any extraordinary difference, where, in addition to prunings, the soil receives large additions of fallen leaves from shade trees.

In each of eight widely separated experiments and on six completely different types of soils at least one type of fermented compost is compared with either sulphate of ammonia alone, or an artificial mixture supplying nitrogen as sulphate of ammonia.

Composts in comparison with Artificials:— In no case was there any sign of advantage from a humus compost, which could be ascribed to its content of organic matter, or any "auxiliary food factor." On the contrary, the effect of the artificial averaged about $2\frac{1}{2}$ times that of the humus compost for the same quantity of nitrogen, even in the third year of application, or later, when residual effects were operating.

An application of one ton of cattle manure or humus compost, which contains about 11lbs. of nitrogen proved to have the value of not more than $5\frac{1}{2}$ lbs. of nitrogen as

*Tocklai Experimental Station Memorandum No. 11 "Experiments with Cattle Manure, Humus Composts, and Unfermented Waste Materials" by H. R. Copper, July 11, 1940.

sulphate of ammonia, that is, of about 27lbs. of sulphate of ammonia. Even at the present war price the value of the latter quantity comes to about Rs. 2-8. Therefore, to render the use of compost remunerative its cost must not exceed half of the cost of the same quantity of nitrogen as artificial.

In two cases where sulphate of ammonia failed to increase growth, humus compost was equally ineffective. This indicates that there is no effect from humus compost apart from that of the nitrogen it supplies.

No advantage appears from the use of cowdung and urine-earth, as a starter, in place of an artificial, *i.e.*, "Dacca" compost proves quite as efficient as "Indore" compost.

Comparison of Raw (unfermented) Waste Materials with Similar Materials after Composting (fermentation in moist heap):—Better results were obtained by applying unfermented materials direct to the soil than by applying the same materials after fermentation in heaps or pits.

Nitrogen is always lost during composting unless perhaps the composition of the mixture and its manufacture are very much more carefully controlled than is possible under estate conditions. To give the same quantity of nitrogen the unfermented materials are not only as efficient but also much cheaper than the composted ones.

It was observed that the woody materials rot so slowly that they take no effective part in the reaction in composting. However carefully the mixture for composting be made up, there is always too low a ratio of organic matter to nitrogen in places, and from these places very soluble forms of nitrogen are rapidly leached out, so that nitrogen is lost. The nitrogen which remains is in forms less readily available as plant food.

The assumption that composting must increase the availability of nitrogen in the raw materials is therefore found to be incorrect.

The Use of Readily Available Nitrogen together with Jungle Cuttings:—The availability of nitrogen in organic

materials is greater as the ratio of organic matter to nitrogen is less. The leaves and green stems (which have a low ratio of organic matter to nitrogen) behave like a quick-acting nitrogenous manure, while the woody parts (with a very high ratio of organic matter to nitrogen) rot very slowly without interfering with the action of the leaves.

Conclusions:—For mature tea it is recommended that the making of humus composts should cease. The operation is costly, it causes losses of nitrogen, the forms of nitrogen which remain are less efficient than the forms in the original raw material, and no evidence can be found that it has any value beyond that of the nitrogen which it supplies.

It seems that fermented materials are better than the unfermented for use with young tea. It is suggested therefore that all cattle manure and urine-soaked bedding be stored in roofed pits protected from surface water by drains. By throwing in other organic waste materials the supply of manure may be increased. It is probably an advantage to sprinkle each heap of about 10 tons organic rubbish with 20 lbs. Nicifos as a "starter."

Three tons of dried Eupatorium cuttings have about the same value as 150 lbs. of sulphate of ammonia. At the present war price of about Rs. 210 per ton including freight, 150 lbs. of ammonium sulphate cost about Rs. 14. This works out to about Rs. 4-9-0 per ton of dried Eupatorium cuttings, which corresponds to about Rs. 2-12-0 per ton of the freshly cut undried cuttings. Wherever such material is conveniently near to tea, it should be possible to cut and carry it into the tea at costs below these prices, for part of the area of each garden.

S. R. MISRA.

(*Continued from page* 86)

exact knowledge of the behaviour of different Indian fruits. However, except for the Punjab and the Bombay Provinces, no systematic investigation in this field is being undertaken. Will the other provincial governments and specially the U.P. pay immediate attention to this problem of increasing importance during these days of war ?

A STUDY OF AN IDEAL VILLAGE IN THE CENTRAL PROVINCES AND BERAR

By

M. L. Kolkhede, B. Sc. (Agr.), Assoc. I.D.I.

(*Continued from previous issues*).

Chapter IX

IMPROVEMENT OF AGRICULTURE AND CATTLE

The poverty of the Indian Agriculturists is generally ascribed, among other things, to the low yield from his land on account of his employing primitive methods of cultivation. Compared with the standard reached in western countries, the agricultural industry in our country is certainly much below the mark. This state of affairs can be improved by drawing the attention of the farmers to the following points:—

(1) *Use of pure seed*:—The yield of any crop depends upon the purity of the seed, as for example an improved variety of Pusa wheat gives higher outturn than the local ones. Moreover, these improved varieties are rust resistant. The same is the case with cotton crop. The improved strains of Verum give more outturn and have long staple which fetches more price. They are also not susceptible to wilt. In the same way every Provincial Agricultural Department has evolved improved varieties of all crops to suit their local conditions. On an average all these improved varieties give from 20 to 30 per cent, more outturn than the local ones and are superior in quality and resistant to diseases. It is, therefore, necessary to sow the pure seed of these improved varieties to increase yield of our crops.

(2) *Proper cultivation*:—Just as a man requires regular supply of food for his maintenance, in the same way land also requires regular cultivation to maintain its fertility. In order to conserve moisture for a longer time, the land should be deeply cultivated before the rainy-season, and then mulch-

ed properly during the breaks. As man requires air for breathing, roots of plants also require fresh air for their full development. It is, therefore, necessary to give interculture from time to time to aerate the roots and to conserve moisture. Frequent cultivation is also necessary for the destruction of weeds which are a great enemy of our crops. But the farmers being under the false impression that frequent cultivation spoils the tilth of the soil, neglect this fact. Naturally weeds grow more luxuriantly and rob much of the food material from the soil which would otherwise have been used by the crop. A wise farmer therefore should not give a slightest chance for the weeds to grow, he should destroy them as soon as they appear.

(3) *Use of Improved Implements*:—By the use of improved implements, I do not mean the introduction of farm machinery which is not suited to our conditions on account of cheap human and bullock labour. But I mean the use of implements like iron ploughs, some harrows, seed-drills, etc., which have really proved to be better for our conditions. Of course it should be remembered that all implements except various types of ploughs are not economic for small farmers, but these are certainly most advantageous for bigger ones, *e.g.*, a Walker's Seed Drill is quite good for farmers having a large area under *rabi* crops, because the sowing time is limited and it is very difficult and troublesome to sow all the area with a Nari plough which can do only 1/6th of the work of the seed-drill. If therefore the farmers want to finish their sowing in time, and get good crop they will have to use the improved seed-drill.

(4) *Use of Fertilizers*:—Although the frequent addition of large doses of fertilizers prove fatal to the plants, still their small doses serve as tonics to the crops. Most of them are used as top dressings when the crops are about one month old. They have a very quick action on the growth of crops, which ultimately give high yield. Fertilizers have been chiefly divided into three main groups:—

1. Nitrogenous fertilizers, containing nitrogen as the chief fertilizing ingredient, *e.g.*, Sodium Nitrate, Ammonium Sulphate, Calcium Cyanamide, etc.

2. Phosphatic fertilizers, supplying phosphoric acid, *e.g.*, Super Phosphate, Niciphos, Bonemeal, etc.

3. Potassic fertilizers, containing K_2O as the fertilizing ingredient, *e.g.*, Potassium Chloride, Potassium Nitrate, etc.

Out of these, Nitrogenous fertilizers are best suited for cereals and Poshphatic for root crops. Our Indian soils generally contain sufficient Potash and hence need not be added. In case of cotton and sugar-cane, the applications of Sodium Nitrate or Ammonium Sulphate have distinctly given high outturns and hence must be used as top dressings wherever possible. The applications of super-phosphate and niciphosphate have also given high yields in case of root crops and vegetables. Beside these, various oil cakes which are rich in Nitrogen (containing about 3 to 8 per cent.) should be used as manure. Their applications specially to sugar-cane have proved to be very successful But to make the best use of edible cakes, it is better to feed them to cattle and then use their dung as manure which will naturally be richer in nitrogen content.

(5) *Preservation of Farm-Yard Manure*:—Farm-Yard Manure forms the best and largest source of manure. It is not only useful for supplying the manurial constituents, but also for improving the texture of the soil. It is a general purpose manure and supplies all the three chief manuring constituents. But to-day the material is totally neglected and left in rains and hot sun which reduce its manurial value. It is therefore necessary to protect this valuable material by putting it into pits. The pits may be 2″ deep with length and breadth varying according to the number of animals, a farmer has. It is better to cover the pits by raising two mud walls by the sides and erecting a tiled roof over it. From time to time, some water also should be sprinkled on it to allow complete fermentation. When the pit is full, it should be covered with a 2″ to 3″ layer of earth. The manure from this pit should be used only after 6 to 8 months when it is well fermented. For this purpose it is always better to have two pits.

To-day this valuable material is neglected in houses as well as in fields. The farmers take their manure to fields

and store it there in small heaps, which are allowed to remain in the hot sun for months together. In this way most of the value of the manure is lost. To prevent this loss, it is always better to cart the well-rotted manure from the pits to the fields, and spread it uniformly with a *raoda* and then to cultivate or plough in a day or two. If the above precautions are taken, then, the value of farm-yard manure will be much increased and the farmers will be able to manure at least double the area with the same quantity of manure.

(6) *Use of Urine-earth*:—To-day the urine of cattle, which is the best source of increasing the supply of manure is totally wasted by the farmers. The urine from a pair of bullocks is as valuable as their dung. It is therefore necessary, to make the best use of this material for increasing the supply of manure. Urine is best preserved by absorbing it in dry earth. For this purpose dig the cattle shed to a depth of 6—9 inches and go on adding a layer of 2—3 inches of earth every month. This earth should be well stirred at least once a week to make the absorption more efficient. In this way within 6 months a farmer will get a layer of urine-earth of 12 to 18 inches height. All this urine-earth should be dug and applied to crops at the rate of about 5 to 6 cart-loads per acre. The plant food in urine-earth is more readily available to the plants than any other organic manure. Thus, a farmer by preserving the urine in the form of urine-earth, can easily double his supply of manure at a negligible cost.

(7) *Preparation of Artificial Farm-Yard Manure*:—With all the proper care of cattle dung and urine, farmers still will be in need of more manure. This need can very well be fulfilled by preparing artificial farm-yard manure from various farm waste products like dried stocks of cotton, *tur*, *juar*, sannhemp and any kind of waste, dried straw and leaves. The value of this manure is increased by the addition of some fertilizers in the process of fermentation This manure when prepared by the addition of fertilizers, is as valuable as the cattle dung, and its cost comes to only about 3 to 4 annas a cart-load. Even to-day in villages cattle dung costs about 8 to 12 annas a cart-load It is therefore very

beneficial for the farmers to increase the supply of manure at a very low cost.

(8) *Proper Rotation*:—Rotation of crops is the best remedy for the maintenance of the soil fertility. By growing the same crop every year soil fertility is decreased because the same food ingredients are taken up again and again. Food requirements of different crops vary, as for example the requirements of legumes are quite different from those of cereals. Crops like *juar* and wheat draw up their food only from the surface soil, while others like cotton and gram exhaust the deeper soil. Legumes like ground-nut, sann-hemp, gram and *tur* have got the property of enriching the soil to a great extent, by fixing the atmospheric nitrogen in it. Some of the important advantages from rotation are:—

(1) Increase in yield.

(2) Suppression of weeds.

(3) Suppression of insect pests.

(4) Prevention of plant diseases.

(5) Maintenance of soil fertility.

It has been found by experiments, both on private as well as on Government farms that rotation for any crop increases the yield of the main crop from about 25 to 75 per cent. In cotton tracts cotton-juar-ground-nut, and in wheat tracts wheat-linseed-gram, have been found to be the best rotations. On the Government Farm, Akola, the above cotton rotation has given on an average, about 250 lbs. more yield over growing of cotton and cotton alone, for a number of years. Thus, by practising suitable rotation, farmers can inrcease their yield at least from 10 to 25 per cent.

(9) *Fruit Culture*:—In almost all countries, fruit culture is a principal source of income to the agriculturists. In our country, there are natural facilities for fruit growing and a growing demand for fresh fruits among the people. But fruit has not yet played any part, in the export of agricultural commodities, on which, it is believed, India's economic prosperity depends so largely. United Kingdom

alone, every year imports fruits worth Rs. 64 crores. Our fruits are allowed in the United Kingdom without any tax and we can therefore easily capture the market, if fruit cultivation is taken up on a large scale on scientific lines. Farmers can get much profit from fruit trees and can add to their decreasing income. The following three examples will give some idea about the profits:—

(1) *Mangoes.*—With distance 30×30 feet, we can plant 48 trees in one acre. Taking 100 fruits per tree, we get 4,800 fruits. These trees are supposed to be of good and delicious varieties like Alphanso and Pairi, which are sold at the rate of a rupee per dozen; thus from an acre we will get about Rs. 400. The cost of cultivation nearly comes to Rs. 200, leaving a net profit of Rs. 200 per acre.

(2) *Oranges.*—Supposing 100 plants per acre, yielding on an average 400 fruits per tree, will give us 40,000 fruits. The minimum rate of good oranges is Re. 1, per hundred. thus giving Rs. 400. The cost of cultivation generally comes to Rs. 150 leaving a net profit of Rs. 250 per acre. Supposing even if the garden is sold on contract we are sure to get Rs. 150 per acre as the net profit.

(3) *Banana.*—Taking 400 plants per acre, and 100 fruits per tree, we get 40,000 fruits. These when sold at the rate of Re. 1 per hundred, we get Rs. 400. The cost of cultivation comes to about Rs. 125. Thus leaving a net profit of Rs. 275 per acre.

On the whole, my study of some of the fruit gardens also shows that we are sure to get Rs. 100 to 200 per acre as net profit. It is therefore hoped that at least big farmers who have got sufficient capital should take the lead in this direction.

(10) *Co-operative Marketing of the Agricultural produce*:—One of the greatest drawbacks in the present agricultural economy of our country, is the most uneconomic system of marketing, that is followed by every cultivator. To-day the fate of our agriculturists is not only dependent on the forces of nature as it was before, but that the world-wide economic forces of demand and supply determine the

price that will be obtained for his goods. The old days of following agriculture as a way of living are gone. It is, therefore, necessary for an agriculturist to take up agriculture as an industry. It is no use only producing high yield, unless there is some organization to obtain the maximum price of it. To-day due to lack of storage facilities, an agriculturist has to sell his produce at once for whatever price he gets. He is completely at the mercy of various middle men and agents in the market.

In order to avoid all these troubles, a Co-operative Marketing Society is a great necessity. This society when formed will take all the responsibility of obtaining the highest price for the produce of the members. It will also receive Government help in all possible directions. Some of the best examples of co-operative marketing activities, are the Verum Scheme, Telengkheri Co-operative Dairy and the Orange Growers Association in the Central Provinces. All those who are taking advantage of these societies are much happier than the rest of the farmers.

(11) *Vegetable Gardening*:—At present by growing ordinary crops, a farmer gets some money only once a year, but vegetable gardening is one of the best sources of getting money throughout the year. Fresh vegetables always find good market in the nearest town. It has been found by the experience of various gardeners that vegetable gardening is also as much profitable as fruit culture. This fact is clearly seen from the financial position of some of the *malis* (a caste which generally follows vegetable gardening) who have been growing vegetable for years together.

Crops like sugarcane when grown for chewing purposes are very paying. Cultivation of chillies, tomatoes, sweet potatoes, onions, etc., is also more paying than the ordinary crops. The average net profit from the ordinary food crops does not exceed Rs. 10, while that of the above crops ranges from Rs. 50 to 100 per acre.

(12) *Introduction of Irrigation*:—Without sufficient irrigation no agricultural country in the world can ever hope to

prosper. It is specially needed in areas where the rainfall is unevenly distributed and scanty. In India many provinces have very low rainfall. The future economic prosperity of such provinces therefore lies only in the introduction of irrigation which is a great necessity. Therefore in areas where there are big rivers, canal irrigation should be started by the Government, and in areas where there are no such facilities, farmers should be given long term loans at a moderate rate of interest, to dig the wells.

To keep pace with increase of population, increased production is necessary, and for increased production sufficient irrigation facilities are necessary. It has been found by experience in case of almost all crops that irrigation gives more outturn for which every farmer is anxiously praying. Without irrigation intensive agriculture is not possible.

(13) *Consolidation of Holdings* :—To-day our holdings are not only sub-divided but are excessively fragmented. The majority of them are uneconomic and do not give full employment to our capital and labour. In the Central Provinces, there is a special Act called the "Consolidation of Holdings Act, 1928," which facilitates the progress of work. Only in the three districts of the Province, namely Raipur, Bilaspur, and Drug, the work has been very successfully carried out for the last 11 years (1926-1937). In these three districts, 1189 villages covering an area of 11,31,547 acres have been consolidated. The average area of a field has been increased from 0·5 to about 3 acres. The average cost of this operation is only annas 4 per acre, while in the Punjab it is Re. 1-4-0 to 1-8-0. The benefits of consolidation may be summarised briefly as follows :—

(1) Individual fields have been reduced in numbers by $\frac{1}{7}$th. It is estimated that even if sub-division of holdings goes on as in the past, it will take nearly a century before we reach the state of fragmentation which existed before consolidation.

(2) 'Chak bandi' has given considerable stimulus to cultivators to improve their land, as it is both simple and convenient to work in a compact holding.

(3) It has saved the cultivators a good deal of time and labour which was otherwise wasted in going from field to field.

(4) Agricultural operations can be done in the whole of the tenants' holdings at the most favourable time, whereas in the past, outlying fields had to be neglected.

(5) The watching of crops is easier and cheaper. Damage by grazing of stray cattle is minimised.

(6) Improved varieties of rice and other crops are more easily grown.

(7) Chances of theft during harvest are minimized.

(8) Chances of disputes on account of encroachments are less.

(9) With improved levels and layout of fields greater benefit is derived from irrigation.

(10) The gross produce of crops in a consolidated village is estimated to have increased by 5 to 10 per cent.

(11) Manure is conserved and more intensive cultivation is possible.

(12) The indiscriminate cutting of grass from field bunds and the wastage of product by small holders is checked.

(13) Improved implements of tillage can now be introduced more economically. New layouts of path-ways which have been made, helped in the rapid transport of implements.

(14) The size of the record of rights has diminished to about $\frac{1}{5}$th of what it used to be, and numerous petty disputes are now avoided.

(15) With full consent of all the cultivators special blocks are reserved for pastures where none existed before.

(14) *Destruction of crop pests* :—Some pests like locust, white-ants, etc., cause a very serious damage to crops. To control these pests various measures have been suggested by the Provincial Agricultural Departments. Some of the methods include the use of various insecticides like

lead arsenate, lime sulphur, led chromate, calcium cyanamide, etc. Although our farmers being ignorant cannot use these insecticides properly, still they can be taught and demonstrated the destruction of some of the common pests by simple means, *e.g.* the Pink Boll Worm which is a very serious pest of cotton can very easily be controlled by simply exposing the cotton seed to the hot sun for 3 to 6 hours, before sowing. With this hot sun the insects inside the seeds die and do not cause any more damage to the crop. In the same way a very serious pest of orange trees locally known as 'Jala' (caused by the insect Inderbella) can be easily controlled by carbon disulphide or chlorosol.

(15) *Control of crop diseases*:—Crops, like human beings, also suffer from many diseases. Some of these diseases like wilt, smut, rust, etc., are very serious and every year cause a great damage to our crops. There are two broad principles on which control methods depend, one is preventive and the other is curative. In a large majority of cases it is the preventive method which only proves to be very successful, *e. g.* dusting of *juar* seed for the control of *juar* smut. Generally the following methods are used as preventive measures :—

(1) Use of healthy seed or parts of plants used as seed. The seed must be selected from healthy plants.

(2) Use of resistant varieties.

(3) Drainage of water-logged fields and proper cultivation.

(4) Employment of hygienic methods. These include the careful removal and destruction of all disease plants or parts of plants so that they may not serve as a source of infection to healthy plants.

(5) Rotation of crops. This is essential, particularly for root diseases so that the fungus may be starved out by not growing a crop on which it thrives.

(6) Destruction of weeds which are susceptible to the same disease as cultivated crops.

(7) Seed treatment. Some seed-borne diseases can be controlled by treating seeds with suitable fungicides.

Improvement of Cattle:—The prosperity of Indian agriculture is closely linked up with the improvement of cattle. Their improvement is not only necessary from the agricutural point of view, but also from the welfare of the human-beings. At present our average consumption of milk, per head, per day, comes to only about 3 ozs., this too in the form of ghee, tea, curd, etc., while that of western countries ranges from 2—3 lbs. To improve this state of affairs therefore, very systematic and drastic measures should be taken both by the Government and the public. The scope for improvement can be seen from the following example. In 1864, a cow's annual yield of butter in Denmark was only 80lbs., it rose to 116lbs. in 1886, to 220 lbs. in 1908, to 285 lbs. in 1912, and in 1936 to 378 lbs. In our country, also, the yield of milk, from some of the important breeds like Montgomery, Scindi, and Hissar, has risen from 5 to 15 lbs., per day, due to scientific breeding and proper feeding on some well managed Government as well as private farms.

In my opinion, the following practical steps should be taken to improve the cattle in every village:—

Scientific Breeding:—As to-day we want more milk and good bullocks, a dual purpose breed like Hissar should be chosen. First of all, all male calves above one year of age should be castrated. A good stud-bull should be purchased from a recognised breeding farm. There should be one bull for every 40—50 cows. If such bulls are not available, then select the best bulls amongst the local ones. These bulls should be maintained either by the Cattle Improvement Society of the village or by some individuals who may be given compensation for the service of their bulls.

Proper Feeding:—Give a mixture of cotton-seed, grain, *juar*, some edible cake and *lakh* or *tur chunti* in equal proportion to the milking animals. The quality should be half of the milk yield of the animal. Along with these concentrated food-stuffs, sufficient fodder should be given to maintain the animals in good health. Grazing areas should be increased either by purchase or by some contribution from all the farmers. The areas should be grazed in rotation and not all at a time.

Proper Care, and Management:—The cattle should not be badly exposed to extreme cold and heat. In rainy season proper protection must be given to them. Animals in advanced pregnancy should be well looked after. Milking should be done at regular intervals. Good sanitation should be maintained by cleaning the sheds from time to time. Preventive measures, during epidemics should be adopted to check the heavy mortality. Along with human medicines, some simple veterinary medicines also should be kept in the village dispensary.

To look after all the above-mentioned cattle improvement activities, there must be a "Cattle Improvement Society", in every village. This society must keep up-to-date statistics about the village cattle and mark the steady improvement. In this way with controlled breeding, proper feeding and careful management, the cattle which are the back-bone of our country, will soon be improved.

Chapter X.

Co-operation And Self-Help

Co-operation must be the slogan, in any programme of rural reconstruction. Without co-operation, there can be no progress. It is chiefly due to co-operation that the Western countries have reached to this high level of civilization. There is no better authority on the improvement of Indian agriculture than the Royal Commission Report which says, "If co-operation fails, there fails the best hope of future India." It is, therefore, necessary to give the first and the foremost place to co-operation in our scheme of rural reconstruction. The following important advantages derived from co-operation, will show us, to what extent it can lead to our progress:—

(1) It kills competition, and gives full value of the produce, when sold through co-operative marketing societies.

(2) Saves the farmers from the clutches of the money-lenders.

(3) Raises the moral, intellectual, social and economic standard of the people.

(4) Checks the tendency of selfishness, and makes the people to take a broader view.

(5) Makes the people happy and healthy beings, which is the ultimate aim of all human activities.

To derive the above advantages of co-operation, the following Co-operative Societies in a village should, therefore, be started.--

(1) *Society for the Improvement of Agriculture*:—This society will look to all the activities necessary for the improvement of agriculture in the village. It will supply pure seed, improved implements, manures, and advise the farmers from time to time as regards the improvement of their economic condition. In short it will serve as a channel to bring all the good to the farmers.

(2) *A Co-operative Credit Society*: - It is necessary to supply credit at a lower rate of interest. This society should be financed by a Central Bank and by the well-to-do cultivators in the village. Credit given to any individual should not exceed more than 50 per cent of the value of his real estate. At the time of giving a loan, it is better to take into consideration the character of the man than his financial position. Loan should only be given for productive purposes, *e.g.* purchase of seed, manure, implements, cattle, etc., and must be realised as soon as the harvest is over. Small-long term loan may be given for effecting permanent improvement in the land, *e. g.* for digging a well, fencing, etc. The amount of long term loans will depend on the financial position of the society. The rate of interest may be 6—9 per cent.

(3) *A Co-operative Marketing Society*:—All the produce of the village must be sold through this society, to get the maximum price. It will save the troubles of the farmers and also get the better price by selling the goods only at the proper time. It will grade the produce and according to its quality. Until the produce is sold, the farmers cannot wait for the money, they, therefore, should be given 50—65 per cent value of their produce, as an advance. In this

respect the society should be financed by the Farmers' Bank in the village.

(4) *Farmers' Bank*:—Agriculture in our country at least, is such a business that we get the money only once a year after the harvest of our crops. It is therefore necessary for all the farmers to deposit their money in this bank and withdraw it according to their needs. This will create in them the habit of thrift and economy. This bank may be divided into two parts, namely one dealing with cash and the other with kind. This latter type will also be useful for the labourers who can deposit their surplus grain for sometime and withdraw it whenever necessary.

(5) *A Cattle Improvement Society*:—This society will look for all possible ways of improving the village cattle. It will maintain some good breeding bulls and castrate all others. It will also look to the sanitation, feeding and health of the cattle.

(6) *A Co-operative Shop*:—A shop of this type is a great necessity in our villages to save the villagers from the clutches of *banias*. He gives them goods of inferior quality at a very high rate. His weights are also false. It is therefore necessary to have a co-operative shop which will supply the villagers with goods of superior quality and correct in weight. The shop may be opened by having a share capital to foster a spirit of co-operation, amongst the villagers.

(7) *A Society for Social Service*:—This society should look after all the social activities, in a village. It should call a monthly meeting of the villagers to create a brotherly feeling in them. They should be given to understand that their village is a big joint family and every one must therefore look to its welfare and progress. By arranging lectures, the society should try to eliminate the evil customs and superstitions of the villagers.

Rich farm soil, well watered, may contain as many as 150,000 earthworms to the acre.

A crow can eat a hundred grasshoppers in a meal, and it eats several times a day.

Errata Slip for the Article "Cotton Breeding Problems in the United Provinces", published in Volume XIV, No. 5 of The Allahabad Farmer.

Page 254, line 3, insert (Season and crop report 1939) after 'in the Province.'

Page 254, line 11, insert (Ramanathan 1937) after 'cotton production.'

Page 255, Para. 3, line 9, insert (Ramanathan 1937) after 'improved types.'

Page 256, Para. 3, line 7, insert (Ramanathan 1937) after 'ginning percentage.'

Page 256, Para. 3, line 17, read "The number of fibres per seed .. .... weight per inch" in inverted commas.

Page 257, line 7, insert (Ramanathan 1937) after 'than the Asiatics.'

Page 257, Para. 2, line 5, read American types are "less hardy .... general cultivation," in inverted commas.

Page 258, Para. 2, line 25, read Konstaninov instead of Konstaniner.

Page 260, line 5, read Hutchinson has opined at Indore "that .... could do" in inverted commas.

Page 261, line 4, read concluded by Hutchinson "that the invasion .... local muslin," in inverted commas and insert after '*bengalensis*' 'from the Hill Tracts of Assam and Bengal.'

Page 262, line 4, insert (Hutchinson) after Khandesh.

Page 262, line 10, insert after 'by the author' '(1935-'37).'

Page 263, under References add the following:—

'10. V. Ramanathan Ayyer, 1937, Proceedings of the first Conference of the Scientific Research Workers on Cotton in India.'

'11. Hutchinson, J. B. 1937, "Evolution of Gossypium and the evolution of the Commercial Cottons" Proceedings of the first Conference of the Scientific Research Workers on Cotton in India'

M. P. Singh.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES.

FOR DECEMBER, 1940.

I—Season.—The first and the last weeks of December, 1940, were practically rainless, but the rainfall in the 2nd and 3rd weeks was above the normal in all districts except the districts of the Meerut Division and Aligarh, Muttra and Agra, which reported rainfall below the normal. On the whole the rainfall during the month was above the normal and was beneficial to the standing crops.

II—Agricultural Operations.—Agricultural operations are up to date. The irrigation of *rabi* crops, crushing of sugarcane and preparation of land for sugarcane are in progress.

III—Standing Crops, and IV—Prospects of the Harvest.—The condition of the standing crops is generally satisfactory and the prospects are favourable. The yield of sugarcane is estimated at about 90 per cent. of the normal.

V—Damage to Crops.—No damage to crops is reported from any of the districts of the province.

VI—Agricultural Stock.—The condition of agricultural stock is satisfactory. The following figures furnished by the Director of Veterinary Services, indicate some improvement in the matter of cattle diseases. Foot and mouth disease, however, has increased to some extent:

Diseases	November, 1940		December, 1940	
	Affected	Deaths	Affected	Deaths
Rinderpest	1,752	873	1,602	909
Foot and mouth	6,210	29	7,120	31
Hæmorrhagic Septicæmia	147	118	89	64

VII—Pasturage and Fodder.—Pasturage and fodder are reported to be sufficient everywhere except in the Budaun District where scarcity is reported in some tahsils.

VIII—Trade and Prices.—The prices of the chief food grains, like wheat, barley, gram, rice and *arhar dal* have fallen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the previous month :

	End of November, 1940	End of December, 1940
Wheat	3·866	3·764
Barley	2·764	2·698
Gram	3·421	3·218
Rice	5·118	5·046
Arhar dal	4·202	3·580

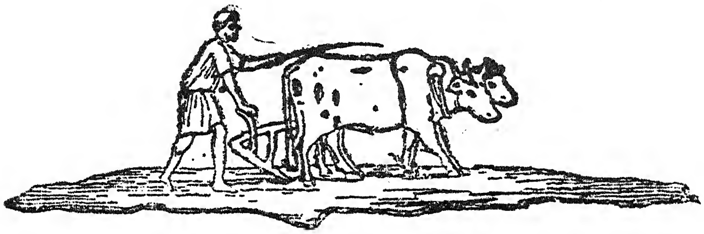
IX—Health and Labour in Rural Areas.—Adequate employment is reported to be available for the agricultural and labouring classes. Stray cases of cholera, plague and small-pox are reported from some districts.

"Pasteurization (*i.e.* heating of milk to about 145°F) is a form of partial sterilization whereby the majority of the harmless souring organisms are killed, together with tubercle bacteria, while tougher micro-organisms escape..................

To advocate pasteurization disinterestedly is a confession of failure to secure decent milk to start with; while to say that pasteurization does not harm milk is to pronounce on the subject of protective qualities of foods, about which our knowledge is by no means complete,—*Dr. Hugh Nicol.*

THE

ALLAHABAD FARMER



VOL. XV] MAY, 1941 [No. 3.

Editorial

The Marketing of Potatoes in India.

The office of the Agricultural Marketing Adviser to the Government of India is to be congratulated on the admirable report which has recently been put out by that office on the marketing of potatoes in India.

The potato is the most popular and the most widely grown of all the vegetables in the world today; and is probably the most widely grown of all the vegetables in this country also. While it is a vegetable that has been introduced into this country in recent times it has shown a steady increase in acreage so that today it has an area of about 499,000 acres in this country, with a total yield of about 49,000,000 maunds.

When it is calculated that approximately 8,553,000 maunds of potatoes is lost every year in storage and during the process of marketing, one can easily understand what a colossal problem the Indian cultivator has to face A loss of over one and a half crore of rupees annually is a problem which has rightly attracted the very serious attention of the Government. A search for better and improved methods of storage is therefore in progress; and it is hoped that the

Government and other agencies working on this problem will, in the not very distant future, be able to devise a method of storage which will eliminate to a very great extent this colossal loss to the country.

The report shows that the United Provinces also has the largest area under cultivation in India, being about 36·1 per cent of the total area in the country. The principal potato producing districts of the province are Farrukhabad, Jaunpur, Meerut, Moradabad, Naini Tal, and Dehra Dun. Gorakhpur, Basti and Gonda districts also have large areas under potatoes, but most of the crop is consumed locally and therefore there is no surplus for export.

The naming of varieties of potatoes has also created a great deal of confusion in the country. It is therefore very gratifying to learn from the report that an attempt is being made to give a satisfactory classification of the varieties. It is hoped that a more scientific classification than the one now given in the report will be forthcoming. Just to group all the varieties into three broad groups (1) the desi, (2) the European, and (3) miscellaneous, may be adequate for commercial purposes, but to a scientific worker it leads nowhere. We therefore hope that those scientists now working with potatoes in this country can bring out a better system of classifying the varieties found in various parts of India.

Another interesting point brought out clearly in the report is that the production of potatoes per acre in this country is very low, compared with the production in other countries. Thus, whereas the average yield in Belgium is 225 maunds per acre, the average yield in India is only about 90 maunds per acre. This yield is also lower than that in Great Britain, Germany, Austria, France and many other countries of the world. And whereas the yield per acre depends a great deal on climate and soil factors, there are other factors such as improved cultural operations, superior varieties, irrigation facilities and control of pests and diseases which may to some extent help to increase the yield of the crop.

The report also points out that India still imports a great many potatoes from Burma, Italy and the Kenya colony in Africa. The average annual quantity imported is a little

over 11½ lakh maunds, or approximately 2·4 per cent of the total average annual supply of the country. The supply from Italy is mainly for seed purposes, especially for the Bombay Presidency. The supply will of course be seriously affected by war conditions; a problem which offers opportunities to seed growers in other parts of India where Italian potatoes can be successfully grown.

Also, while there is at present no surplus production of potatoes in the country, the report has very rightly drawn the attention of the country to many other industrial uses of potato which may help to increase its production. For example, this country at present imports annualy on the average 119,022 maunds of farina or potato starch valued at Rs 672,989. This product is largely used in textile mills. If the demands for farina and potato flour were met from the produce in this country, there would be scope for increasing the area under potatoes by about 10,000 acres.

The manufacture of alcohol from potatoes and the production of dextrin and glucose are other lines of industry which are being followed in some of the advanced countries and to which the attention of the country has been drawn. These starch products will certainly have to compete with those that can be obtained from rice. And therefore unless the cost of cultivation of potatoes can be materially reduced by such methods as the introduction of heavy yielding varieties, the provision of cheap manures, and economical methods of storing, any attempt to manufacture these products from potatoes may prove a failure.

The report has also drawn attention to the lack of proper market intelligence, the absence of standard weights and measures throughout the country, the improper methods of packing, the improper and uneconomical methods of harvesting, the lack of standardization or proper grading, the absence of proper methods of marketing, the great amount of loss during storage for seed purposes, the very high and improper methods of charging freights which prevail in most parts of the country, the problems connected with distribution, and the lack of co-operative marketing associations or producers co-operative associations, all of which would considerably help the farmer in getting his proper share of the produce.

RICE BREEDING IN INDIA

By

D. P. Mazumdar B. Sc. (Ag.)

Introduction

Rice is the most important staple crop of India. The area under this crop is much larger than any other single crop and it constitutes one-fourth of the total clutivated land. One of the most striking things about rice is that though the area under it is very great yet India has to import 12 to 14 lakhs of tons of rice every year. Such imports, it is often held, not only constitute a drain on the wealth of the country but help to depress prices for the Indian producer. So it is obvious that we in India must increase our production of rice to ensure domestic requirement. As very little new land is available the solution is to increase the outturn of rice per acre.

Now the following figures will give an idea, how far India is behind in respect of her production per acre as compared with other countries

Production per acre (cleaned rice).

Spain	5,730 lbs.
Italy	3,960 ,,
Japan	3,350 ,,
Egypt	2,760 ,,
India	884 ,,

Our per acre yield is $\frac{1}{4}$ of what Italy or Japan produces, whereas the per acre production in Spain is nearly 7 times that of what we get in India.

So, for crop improvement, the first attempt should be local selection followed by introduction of better types and varieties from outside. When these two attempts fail we have to resort to breeding work.

Hybridization is employed in order to create variability for further selection, and it should be realised that, since selection is the process which mainly works, hybridization is only a means to make it effective. Usually ten to fifteen

per cent. increase in yield is readily obtainable by simple selection and it would probably be possible to increase it by another 10 per cent. by ordinary hybridization work among varieties ; but greater scope appears to lie in the breeding of such characters as, better quality of prcduct, better standing power of straw ; earliness of ripening, resistance to fungus diseases, etc., which contribute to yeild indirectly. Much work on breeding has been done in the West, but rice being a tropical crop where scientific breeding has been started recently, there is a vast field of work in this direction. Different countries of the tropics have more recently given attention to this aspect of the problem. In India regular plant breeding work on rice was commenced in 1914 with the appoint ment of a special botanist and the opening of a special station at Coimbatore. The chief aim of plant breeding in rice as in any other crop is the production of new varieties which will bring to the grower a greater return than he is getting with the existing varieties.

It is obvious that an immense improvement in the rice crop should be made in this country in order that we may compete with the other countries in the yield per acre Though it is true that agronomical practices have also a great part to play in the production, yet improvement in varieties towards yield and other economic characters also count much.

Technique of Breeding in Rice

It is needless to emphasise that the breeder should have a clear-cut picture of the type he wants to produce, and its relation to the agricultural and climatic conditions of the tract, before he actually resoits to the method by hybridization. Since the process involves much time and careful work, it is likely to be a laborious one and expensive. It generally takes 8—10 years or even more to produce a type. The next step is the careful choice of the parent, as much of the success depends upon this preliminary selection. The parents themselves should also be pure, and it is always safe to test the parent for purity by trying them for a few generations and watching their behaviour. The general rule followed in crossing is to always cross those parents which

possess the maximum number of factors which one would like to be present in a type.

In hybridization the technique to the studies of the cross progenies applies to the technique of the series of operations involved in the ordinary selection. Great care is needed at every stage of the work. The cross seeds are usually first sown in separate plots along with the parent and then transplanted in the field. Though self-fertilization is the rule, natural crossing can take place. In order to be absolutely sure, it is better to self a few plants in the F1 stage. Selfing consists in enclosing the whole plant within a cloth bag to prevent any foreign pollen getting access to it.

Botanists working on rice in India and elsewhere have evolved their own methods of performing crossings and are on the lookout to improve them. The method practised in the Phillipines and in Java consists in cutting off the half of the flowering glumes, crosswise, on the previous evening, emasculating them, and pollinating the stigmas the next morning.

"Sarangpani" working in Bengal has adopted a method which consists in pulling the two flowering glumes apart by holding the tips gently, just an hour or two before the natural opening commences emasculating them and tying the glumes with a fine silken thread after the pollination.

R. K. Bhide working in Bombay suggests the removal of all the anthers when they are beginning to emerge out naturally. I y this method a few flowers may be emasculated in a day. So he further recommends the artificial opening of the glumes with least injury to them, if it is desired to handle a large number. He also recommends the growing of the plants to be used in the cross in pots rather than in the fields.

The method practised in Coimbatore is to open the two flowering glumes just two hours before the natural opening of the flower. It is done by inserting a pair of forceps at the end of the spikelets between the glumes, when the glumes are fairly apart. Emasculation is done by removing

the anthers by holding the filaments. The emasculated spikelets are kept enclosed in a muslin bag until pollination is done. The actual pollination is done by holding the dehiscing anthers with a forceps over each of the emasculated spikelets, and gently tapping the forceps until enough anthers have shed over them. The method of enclosing pollinated spikelets in cloth bags though practised in early years, is not strictly observed now, as it interferes with the proper setting of the grains.

All the methods described above necessitate the handling of the glumes in some way or other, and on account of their extremely delicate nature a cent per cent success is impossible. Where the spikelets are comparatively large, about 80 per cent success has been attained by efficient breeders, but on the other hand, where the spikelets are comparatively small, the success may be as low as 10-20 per cent.

Much study has been made on the subject of the blooming of rice in different parts of the world. These studies indicate that although a certain set of conditions brings about the natural opening of the glumes, the temperature, and probably sunlight play a very important part. The method adopted to raise the temperature surrounding the flowers consists in the use of paper bags of different colours. Black and brown paper bags were found to be most effective as they possess great absorbtive powers

In cases where glumes are made to open before the natural time by enclosing the panicle in paper bags, the anthers come out without dehiscing at all, because the factors governing flower opening are different from those concerned in the dehiscence of the anthers. This made emasculation very easy and one can do crossing work very successfully. The artificial hastening of the opening of the flowers in the plants is not of any help when it is used as the father, as the anthers that come out in such a way never dehisce, except in a few special cases.

Now the method of crossing, according to the above principles is in selecting a panicle in a plant that has started flowering the previous day. This plant is to be used as

mother. The already set spikelets are removed. The panicle is then covered with a brown paper bag. The enclosing will have to be done just 1 to 1½ hours before the probable time of normal opening, which can be foreseen by the prevailing weather conditions. If the cover is removed after 15 to 30 minutes, depending on the degree of sharpness of the sun, all the spikelets which are to be opened that day are found to have opened in a flush. The anthers are removed at once, and the pollination can be done as soon as the pollen is ready in the plant to be used as father. After the pollination all the closed spikelets should also be removed. The method is specially good when a very large number of crosses have to be done.

Mr. N. E. Jordon of America suggests the hot water emasculation of rice flower with great success. The panicles are immersed when about 2/3 exerted, in water at 40—44 C in a thermos bottle. This treatment kills the pollen without injuring the rest of the flower.

Also cold water (O° C—3°C) has a similar effect but less effective than the former.

Cytology in relation to plant breeding

(*a*) *Chromosome theory of heredity*:—Recently the possibilities which have aroused the greatest interest and expectations in plant breeders have come from the great advances that have been made in cytology, and the study of chromosomes In the beginning of the present century it was found that the union of parental chromosomes into synaptic pairs and their subsequent separation in the reduction were exactly parellel to the Mendelian segregation of characters and this indicated a possible connection between chromosomes and heredity.

(*b*) *Heteroploidy*:—A large number of plants were examined for their chromosome numbers. It has been found that the chromosome number is constant for every species and that many of them have chromosomes in multiples of some basic number. Most of our cultivated plants like rice, wheat, oats, sugarcane, cotton, etc., are now known to have varieties or species possessing multiples of a basic number, so

that there is no doubt that evolution of many plant genera has been accompanied by multiplication of chromosome numbers. In some cases where the chromosome numbers are not exact multiples, they have been explained as being due to some chromosomal irregularities. That these chromosomal irregularities produce progenies with different numbers of chromosomes is also evident from recent studies in rice in Coimbatore. Plants with half the diploid number due to failure of fertilization and development of the egg; and plants with double the diploid number, *i.e.*, tetraploids arising by "endo-duplication" in somatic cells have been observed. Plants with three times the basic number, *i.e.*, triploids have also been isolated being the result presumably of "endo-duplication" in sexual cells. All these plants in virtue of their chromosome numbers are sterile in varying degrees and yield progenies with varying chromosome numbers. The triploid has been found to give plants with different number of extra chromosomes (Polysomic) besides the normal number showing an inverse relation between the stature of the plants and their chromosome numbers. One extraodinary feature of the polyploids is that their stature and vigour are found to be usually associated with the number of chromosome sets they contain. While the haploids with the basic number are dwarfish, the polyploids with multiples exhibits gigantism of morphological parts and on this account many of them are economically useful.

(*c*) *Production of new form* : - The knowledge that increase in number of chromosomes goes with increase in the size of the chromosome sets so that the plant arising from such duplicated sex cells may be bigger and more productive, has been found to be very useful This doubling in an otherwise sterile hybrid (F1) between two species having different chromosome numbers, may give fertile offspring as the partnerless chromosomes now get their partners. A number of such plants with duplicate chromosome sets have been secured both naturally and artificially from the sterile F1 in the intergeneric crosses. These plants which arise from doubling of chromosomes are so different from the originals that they are usually put into a different species or even genus. All the plants with different chromosome numbers

are being studied in rice. The crosses have been made in different species of rice, *i.e.*, Oryza sativa × Oryza Latifolia and O. Sativa × O. longistaminata. The F1's were sterile but when back-crossed to sativa parent again gave some seeds.

Mutations :—Besides changes in whole chromosome numbers there may be changes in the Mendelian units located in the chromosomes or in portions of chromosomes These are called mutations and these mutations do occur in nature, though rarely. It has been demonstrated however, that mutations can be artificially induced by subjecting the material, seed, plant, pollen, etc., to X-ray In this way new unit characters, as contrasted with new combinations of existing characters produced by hybridization, may be placed at breeders' disposal. Rice subjected to X-ray at Coimbatore has produced a number of mutation, some of them entirely new and some which have already been observed in nature. That X-rays bring about changes in chromosome is evident from the large amount of unsetting caused in plants from X rayed seed Most of the mutation obtained so far have been on the negative side only, *i e.*, they do not show any valuable characteristic not present before, but the work, from the analogy of results obtained in other plants, is full of possibilities.

Work in Different Provinces

With this much about different methods, we should now have an idea of the hybridization work that is being done in different provinces of India.

United Provinces :—Hybridization has been practised with the object of improving the yield and quality of various strains and also to keep away the attack of the gundhi fly (Leptocorisa varicornis) which sucks the grains and destroys the crop. *Sathi* rice which is early but poor yielding has been used in hybridization, which by virtue of a leaf covering escapes the attack of the gundhi fly. Hybrid strains immune to the fly have been obtained.

The crosses between early and late types are also being made. Observations on sheath, glume colours, self sterility,

grain sizes, kernel colour and flowering date, height, tillering, resistance to lodging, shedding and yield, are being made. Some hybrids are already in distribution and more are likely to be released after exhaustive large scale yield tests at Nagina.

Central Provinces:—Work in the Central Provinces is being conducted in the following directions: (*a*) the study of the inheritance of endosperm characters, (*b*) isolation of prolific strains with bold and translucent rice, suitable for the export market, (*c*) the study of the inheritance of scent in rice and (d) study of the inheritance of growth habits, with a view to infuse erect habit in the high yielding strains which are usually of lodging habit.

Bengal.—With a view to evolve high yielding strains of rice that conform to trade requirements some economic crosses are being made. In Bankura attempts are being made to cross some local varieties with improved exotic ones.

Work is also being done on the evolution of a drought resistant variety with high yield. This character has already been demonstrated to be a hereditary one.

Bihar.—One of the main objects of the work in Bihar has been to make a genetical study of the inheritance of characters in rice and the production of new economic types by hybridization.

A study of the blooming behaviour of various paddy varieties under Bihar conditions have been made.

Various improved strains have been isolated which are being tested on a large scale prior to general distribution.

Orissa,—Work in Orissa is being conducted on the following lines:

1. Evolution of high yielding strains.

2. Evolution of suitable strains of paddy by selection or hybridization for the (*a*) Flooded tracts (Occasional flooding of about 10 days.) (*b*) Low lying land, (*c*) Saline tract, (*d*) Dalua or pat land, *i.e.*, lands submerged for considerable part of the year

4. Evolution of early strains of paddy (Beali) for serving the problem of food supply to the poorer classes which become very acute in the month of June and July.

5. Cytologycal studies with a view to explaining the morphological differences which are met with in some gigantic types of paddy.

Assam.—Hybridization is being done for evolving a fine-grained *boro* variety by combining the hardiness of the *boro* (spring paddy) with the fine grain of the *aus* (summer paddy).

The studies in the inheritance of quantitative characters such as grain size and linkage relationships have been made and are still being persued further.

Bombay Presidency.—The work in Bombay is being done by B. S. Kadam; G. G. Patel and V. K. Patemkar at Karjat.

A study into the manifestations of hybrid vigour has been made which was found to be usually absent as regards height, tillering, panicle length, and weight of the whole plant.

Madras Presidency.—Disease resistance. A fungus disease "Pericularia oryzae" was very prevalent in Madras in some varieties. A crossing work has been done with resistant varieties and there have been obtained some strains which are quite resistant to the attack of the disease.

Straw character. A simple strain Co. 3 has been crossed to one of the types with a stiffer straw character. A few strains have been evolved from this cross which while possessing greater rigidity in the straw and greater freedom from shedding, are giving a definite increase in yield.

Crosses with wild rices. The wild rices have all the undesirable characters except their highly drought resistance and the greater freedom from plant diseases. Crossing between wild and cultivated types has been done at Coimbatore and it appears possible to evolve types having a drought resistant character of wild rice but without its undesirable characters.

germs. Thus the disease spreads. This brings us to the problem of the control of these pests.

General Methods of Control. (*a*) *Mechanical and Physical.*—There are some methods of control which may be used for all domestic pests. The first is the cleaning of the house. At least once a year apart from the daily cleaning, the whole house should be thoroughly cleaned. If this is done in early spring when so many pests breed, or just before winter when many adult pests settle in some warm secluded place to spend winter months, it would prevent the multiplication of these pests.

The second is the mechanical means of control. This is accomplished by taking advantage of the knowledge of the pest's mode of entry into the house, of its food, and of conditions for successful breeding. The use of insect traps of various types is an effective means of control. Since some pests such as the housefly, breed in decaying material, it is essential to keep covered all garbage and household refuse (which should be destroyed daily), and also to attend carefully to the sanitation of the house. Doors and windows should be provided with wire screen

The next is the physical means of control which can be very successfully applied to some pests. This consists in destroying them by exposing them to high temperatures. Books, clothing and such small articles infested with pests can be exposed to the sun during a hot day.

(*b*) *Chemical means of control.*—The various chemicals used in the control of insect pests can be classed under the term insecticides. These include repellents, poisons and fumigants The odour from certain volatile substances seems to be so obnoxious to certain insects that they keep away from the vicinity of these substances. Naphthalene, camphor, citronella oil, kerosene oil and petrol are some of the common repellents. There are also stomach poisons and contact poisons. The former are introduced through the food of the insect particularly taking advantage of the preference shown by many pests for certain kinds of food. The latter are used mostly in the form of sprays of liquid poisons.

Formalin (formaldehyde), pyrethrum powder, sodium fluoride, sodium arsenate, and borax are some of the effective stomach poisons. Spray made of pyrethrum powder and paraffin, creosote and turpentine are contact poisons. The third group of chemicals are fumigants or respiratory poisons. They are harmful to man also if inhaled in large quantities. Hence their use is limited. However, these are suitable for use in places which can be completely closed for twenty-four hours. Sulphur (burning), hydrocyanic acid gas, carbon bisulphide and carbon tetrachloride are commonly used as fumigants.

Control measures for particular insects.—Some of the more common and troublesome domestic pests are bed-bugs, lice, silver-fish, cricket, cockroach, ant, white ant; house-fly and spider. As the habit, life-history and control measure of each of these differ from those of the other, each pest is taken up below separately.

Bed-Bug.—This insect lives and breeds in cracks and crevices in the furniture or in the structure of the house. Blood is the only food of this pest, and it prefers human blood.

Prevention is the key note of the bug problem. Eliminate all potential "homes" of the bug. More careful attention should be given to the cleaning of homes. After travel, bedding, clothing, hold-all, boxes, etc., should be carefully scrutinised to see if any bug is brought in through these. In case of acute infestation fumigation can be successfully applied

Lice.—These are small wingless insects living in the hair of mammals and the feathers of birds Their mouth parts which are adapted for piercing and sucking can be withdrawn into the head. They live on the blood of their host. The human louse is a very nasty pest of dirty people. Such a person passes it on to others, often to clean persons also in any momentary contact of the body or clothing.

Careful attention to cleanliness of person and clothing is the surest way of preventing an infestation. In the case of a minor infestation of hair lice, it is enough to comb the hair with a fine comb damped with vinegar or liquid paraffin.

Silver-Fish.—This is also a small wingless insect with flattened, elongated body having silvery scales which give it a glistening appearance It shuns daylight and likes to be in the dark. It can be easily found behind picture-frames, inside books, and in dark crevices of the house. As it feeds upon anything containing starch or sugar, the binding of books, the gum of labels and photograph mounting are often devoured by the pest. To prevent an infestation it is essential to maintain constant dusting and cleaning of shelves and cup-boards where books, papers, etc., are kept. Starched clothing should be frequently aired. If by chance any sugar or syrup falls on clothing it should be washed before putting away. As the pest likes warm places, it will be better to keep starched materials in a cool place. All cracks in the house and furnitures should be sealed. Napthalene repels the pest. For destroying the pest advantage is taken of the insect's liking for starch. Add 12 parts of sodium fluoride to 100 parts of flour and mix to a paste with water. Apply this paste on one side of small pieces of flexible cardboard, roll them into cylinders with paste inside and leave them in the infested parts. The pests which are attracted to the bait are poisoned.

Cockroach.—Everyone knows a cockroach and what harm it does. The amount of food it devours is negligible but the amount it spoils and taints is tremendous. It leaves a roachy smell wherever it goes and this makes it more repulsive. Very often also it leaves its excreta in the food it eats. Hence, the food should be kept under cover and the kitchens kept clean.

Powdered naphthalene sprinkled on the floor acts as a good repellent.

House Cricket.—This pest somewhat resembles a cockroach, and can be very easily distinguished by its clumsy legs and long feelers. It is not very harmful although it does some damage to clothing. The cricket annoys us by its long, irritating chirping noise by which the male cricket attracts his partner. Usually it invades the home during cold weather and lives in cracks, crevices, partly closed boxes and very often behind picture frames.

Various methods are used to control the pest. It can be poisoned with a paste made of flour to which sodium fluoride has been added. The paste is put on cardboard and left near cracks and crevices where the pest lives. Another method usually applied is one which takes advantage of the pest's liking for sweetened vinegar. A deep wide mouthed bottle or jar is filled with sweetened vinegar. It is then kept where the crickets abound. The insects are attracted by the smell and in their attempt to get the sugar, they fall into it and get drowned.

Ants.—These little creatures are well known for their social habits, their remarkable industry and their elaborate homes. Two kinds are common in these parts; the small red variety and the black variety. The latter invade the home in great numbers in their search of food, especially sweet substances. They are more in the nature of nuisance pests as they will get stuck in jam and honey, or get drowned in milk, or wander in the sugar pot.

If the place of their entry into the house can be traced (this is often a tiny crack), a piece of cloth soaked in syrup placed near the entry will attract the ants until the cloth becomes filled with ants. The cloth with ants can be put in boiling water and the process repeated.

The best way to control them is to locate their nest and destroy it and the contents by putting it on fire. But very often it is impossible to find the nest. In that case poisoning can be resorted to. An effective ant poison can be made by mixing 1·4 gms. of sodium arsenate, approximately ·2 grams of sodium carbonate and 150 gms of sugar. Add 190 cc of water to it and stir well. A syrup will be obtained. Wet some cotton with the syrup and keep in a shallow plate away from places where dogs and other domestic animals might get a chance to lick it. The ants are attracted by the sugar and on eating they are poisoned.

White Ants.—These are insects having a social life like bees. They live in colonies and the work of the colony is divided among the specialized castes like the queen, soldier and worker. They are totally subterranean in their habits,

Their chief food is cellulose material, hence they are of great economic importance partly as useful insects as they turn out roots and stubs of harvested crops into soil. At the same time they can become pests if they prefer to eat books, furniture, etc., in the home.

The best form of prevention is to avoid supplying them a source of food. All waste paper should be burned or sent to the manure heap. Do not let paper or clothing remain heaped up in the house for a long time. All cracks and crevices on the floor and wall-shelves should be closed with cement. Frequent cleaning and application of repellents like kerosene oil and creosote over the infested places drive the termites away. If they come out of holes on the floor or walls, blowing in some paris green or arsenic powder into the holes would ultimately destroy them.

House Fly.—Most of us would place the housefly as pest No. 1. Besides being a great nuisance, the fly is a harmful pest as it spreads diseases like cholera, typhoid, dysentery. They invade our homes mostly in search of food. So effort must be made to prevent their entry into the homes as that is one way of controlling them. The fly visits filthy places in order to lay eggs and unknowingly it carries some filth, very often containing disease germs, on the bristle-like hairs on its body and legs. Later when they crawl over our food the filth is deposited on it. It has been noticed that the housefly spends most of its time flying from food to breeding place and back again to food. Not only does the housefly leave the filth on the food as the fly crawls about, but, if the fly has fed upon human feces containing disease germs, these may be regurgitated or excreted on our food. However, the fly is active only during day time as it hides somewhere during the night

The best way to prevent this pest is to give no opportunities for breeding. Household refuse, rotting vegetation, cowdung heap, etc., are potential breeding places of the housefly. Therefore all garbage should be buried every day. No waste matter should be allowed to remain at one place for a long period. It should be removed and burned regularly. Similarly human excreta should never be left open so that the fly can visit it.

Apart from the prevention of breeding, as many adult flies as possible should be exterminated. As far as possible the house should be fly-proof. Small-mesh wire screen for doors and windows will prevent their entry into the house.

Flypapers and traps are other effective ways of controlling this pest. Flypapers can be purchased or made at home. Warm 5 parts of castor oil and 8 parts of resin until the latter is dissolved. The warm mixture can be applied thinly to strips of glazed paper. Hang these at various places in the house. The flies are attracted, get caught and die. In making a fly-trap formalin is used. Make a solution containing 6 parts commercial formalin (40 per cent), 3 parts sugar, 50 parts lime-water and 41 parts water. Nearly fill a jar with the solution and cover it with some blotting paper which is kept moist by two strips of blotting paper passing from the cover into the liquid inside. The flies are attracted to the wet cover over the sweet liquid, sip some from the saturated blotting paper and are poisoned, but are prevented from falling into the liquid The dead flies which fall around the trap should be burnt or buried.

Spider.—These do no harm to man, his food or his property, but their loose untidy web in the corners of walls are very unsightly if left undisturbed and necessitates frequent cleaning. The life history of the spider is very interesting. The female spider spins a web and remains at the back of it. The male spider enters the web and after pairing, the female eats him up She afterwards lays her eggs in a cluster and leaves her nest and proceeds to make another. The eggs hatch out into a large number of small spiders which feed upon the insects entangled in the web till they are fully grown. They then leave the snare and each female spins a new one.

All webs should be destroyed before the female has had time to lay eggs. Also all adult spiders should be killed while destroying the webs. They have an easy way of escape by falling on the floor and hiding under something as soon as one touches the web If one disturbs the web and another person looks on the floor at the same time, the spiders can be killed before they get time to hide.

GREEN MANURES WITH SPECIAL REFERENCE TO PADDY*

By

RAZI HAIDAR NAQVI, B. Sc. (AGRI.)

Senior Research Assistant, Rice Research Scheme, Bihar, Sabour.

Introduction:—The nutrition of a crop is a matter of supreme importance and a farm can be maintained on commercial basis only by adequate manuring. The manure of a cosmopolitan nature in the whole of India is cowdung. Its high food value for the plants is well known to all the cultivators and in spite of all this cowdung cakes, specially in the villages, constitute the chief fuel, and as such its supply is limited. Under the existing circumtances, it is firstly rather difficult to apply any manures to the vast areas of fields in which paddy grows and secondly the kind of manure to be used depends upon its availability and cost. Chemical fertilisers and certain cakes like "Neem" and "Castor," besides being relatively costly, are likely to be washed away by rains and floods which are so common during the paddy season The application of green manure is, therefore, being recommended by the Rice Specialist, Bihar, for all areas where crops like 'dhaincha' or 'sanai' could successfully be grown soon after the onset of rains. Application of this manure to paddy fields is not only easy but very economical and hence it would not be out of place to give a brief account of the crops used for the purpose, method of their application and their utility to the paddy crop.

Definition:—Green manures are those soil improving crops which are grown to be buried under the soil or applied, after artificial decomposition, to the fields in order to provide

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sufficient amount of organic matter and to make the fields more retentive of moisture and plant nutrients by improving the physical character of soils.

Historical:—Green manuring is not a new method of maintaining soil organic matter. It has received a very general attention in nearly all the agricultural countries of the world. The Romans, the Greeks and the Chinese were following this system even before the birth of Christ. In India, we find an account of experiment conducted at Cawnpore, Dumraon and Nagpur in Agricultural Ledgers, 1893 and 1897. The experiments at the Cawnpore farm were, as a matter of fact, in progress for fifteen years at the later date. Hence research work on green manuring was done as early as 1882 in Cawnpore with wheat following Indigo. The increase in yield was about 50%. This increase in yield quoted here was an average of 8 years prior to 1893. Round about Bangalore and Tinnevelley, trees used to be grown along the banks of water channels and round about the rice fields whose leaves and tender twigs were cut once every third year and incorporated in the soil by trodding them under foot. In 1902 the Department of Agriculture, Bombay, and the Department of Forest, Madras, took a great interest in increasing the leafy green manure for the benefit of the public. The topping of pine and similar other trees for the use of green manuring in the hilly reigons of the Himalayas are but a few of the interesting facts regarding the indigenous practice of manuring which suggested the carrying out of a systematic research on the subject.

Crops used as Green Manures:—One or more of the following crops are used for green manuring purposes in different parts of India.

1. Groundnuts.
2. Soya beans.
3. Arhar—Rahar.
4. Urd—Kalai.
5. Indigo.
6. Sunnhemp.
7. Dhaincha.

Factors governing the choice of a crop—Various crops mentioned above respond differently to different conditions and hence the following points should be taken into

consideration while selecting a crop of green manuring for a particular tracts:

1. Climate.
2. Type of soil.
3. Period of growth of the green manuring crop
4. Rate of growth and time required for its decomposition.
5. Amount of organic matter added.
6. Facility for inter-cropping.
7. Crop-selected is legume or non-legume.
8. The type of development of its roots.

In the light of the above points a crop for green manuring purposes should add much of organic matter and put in a maximum growth within a short period and so far as possible be a leguminous one with soft stems which do not take a long time for their decomposition. The roots of a leguminous crop develop small nodules which are very rich in nitrogen and are, therefore, an additional source of plant nutrient.

Crop suited for manuring paddy:—Sunnhemp and Dhaincha are the two leguminous crops which are suitable for paddy. Both of these crops grow quickly, give a good yield of green stuff to plough in and rot in a very short period. Sunnhemp is succeptible to standing water in the fields while Dhaincha withstands it to a sufficient extent during its period of growth Dhaincha i , therefore, more suited to lower terraces of fields where there is a constant danger of the accumulation of water while sunnhemp could be used in comparatively higher levels where the water is not likely to stand for a long time.

Efficiency of green manures:—The controlling factor in the case of green manuring is the rainfall following its burial for its complete decomposition. Negative results are of common occurrence when the manure does not decompose thoroughly. By negative results is meant a decrease in yield instead of an expected increase. If the rains fail, it is always safest to give an irrigation to ensure proper rotting, which generally does not happen in the case of paddy which in itself is dependent on rains and requires a large amount of water even in its earlier stages. Sometimes initial stages of decomposition are carried out under artificial conditions as a safeguard against negative results in years of scanty rainfall.

The only care that one has to take, is to see that the manure has thoroughly decomposed.

How Green Manures help in Increasing the Yield.—

1. Soil receives organic matter which contains essential elements of plant food such as nitrogen, phosphate and potash, etc.
2. Mineral nutrients from the sub-soil are brought up to a sufficient extent.
3. Accelarate the bacterial action in the soil.
4. Improve the texture and structure of the soil.
5. Make the potash and phosphorus available.
6. Prevent the leaching of suitable minerals from the soil. These green manures are specially suited to sandy soils where the plant food (in the form of nitrates) leaches to a depth of about 36 feet.

Raising and Burying in of Green Manurial Crops.

In irrigated tracts the best time of sowing Dhaincha is the last week of May or the first week of June but in non-irrigated areas the general practice is to broadcast the seed on getting the first showers of rain. The seed rate for Dhaincha is about 10 seers per acre and that for sunnhemp about 15 seers to an acre. The cost of seed is about a rupee only, but the profit that is obtained by green manuring is many times the sum spent.

When the crop attains a height of about 3 feet or so it becomes ready for burying in. In the case of paddy, the crop should be buried in the soil about 4 or 5 days before the actual transplanting of the crop takes place. The standing crop of green manure, if intended to be buried in the same field in which it is grown, is laid down with the help of a wooden beam (henga, and then it is turned under an iron plough which is worked in the same direction as the 'henga' in order to completely cover up the stalks of the crop. The buried crop rots very thoroughly if it receives some rain water within a few days of its burial as in cases of scanty rainfall it does not get enough of water required for its decomposition.

The efficiency of green manure is further increased if some half a maund of superphos per acre is also added to the field.

A STUDY OF AN IDEAL VILLAGE IN THE CENTRAL PROVINCES AND BERAR

BY

M. A. KOLKHEDE

B. Sc.(Agr.), Assoc. I.D.I.

(Continued from previous issues).

Chapter XI.

VILLAGE PANCHAYAT

From Mahatma Gandhi to Sir James Grigg, the Finance Member of the Government of India, every one rightly wants us to start from the village, if we want to achieve the real reconstruction of our country. Mahatma Gandhi went so far as to say that he would lay the foundation of our future constitution on the village Panchayat.

The village Panchayat can do much to encourage and organize the cultural life of the village. It is necessary, therefore, to have a Panchayat in each village, to make it a self-governing unit Everything in the village will be settled by the Panchayat which is the true representative body of the people.

The Panchayats should be given more powers to settle all the disputes in the village itself; because the members of the Panchayat are more thoroughly aware of the situation in the village than the courts which are far away. What the Panchayat can do to improve

the conditions of our village can be enumerated as follows :—

It can,

1. Conduct night-classes for adults,
2. Start a village library,
3. Keep good roads,
4. Maintain a village school,
5. Prepare good rural teachers,
6. Help at times of famine and distress,
7. Settle litigations,
8. Look after the village sanitation,
9. Start a social service league,
10. See the working of bazar, cattle-pound, etc.,
11. Give training in citizenship,
12. Perform rural dramas,
13. Arrange for lectures and demonstrations,
14. Help cottage industries,
15. Start a village dispensary,
16. Look to the water-supply,
17. Arrange for play grounds,
18. Look to child welfare.

To carry on all the above-mentionod activities, the Panchayat must get at least 50 per cent of the revenue of the village. When looking to its service to the villagers, the Panchayat fully deserves to get that much share (at least 50 per cent revenue) in the land revenue of the village. When a Panchayat will be established in every village, the village will very soon rise to a high level of civilization. There will be a change in the social, economic, religious and political conditions of our villagers and we will thus have a new era of civilization.

Chapter XII

Sanitation and Health

No nation, the individuals of which are living in dirt, can ever hope to prosper. To-day our villages are full of dirt which gives rise to epidemics causing a very heavy mortality. Due to our unsanitary conditions of living and insufficient supply of food, our average life, has come down to as much as 23 years, while that of countries having good sanitation and health, it is 50—55 years. This is all due to the ignorance of our villagers.

Maintaining cleanliness in the house and in the village, does not involve any extra expenditure except some knowledge about the importance of sanitation and health. The following simple ways of maintaining sanitation and good health in a village are therefore suggested :—

(1) *Fresh and pure water* :—Water is a prime necessity of life and must be clear, tasteless, odourless and perfectly pure. Well and river water is best for drinking. Always use clean pots for drawing water from the well, and keep the surroundings clean. In case of rivers, reserve some special area for drinking purposes and do not allow cattle to sit there or human-beings to wash their clothes. In rainy season always add potassium permanganate to water whether it be from a well, river or tank.

(2) *Well Ventilated Housing* :—To lead a healthy life, sufficient pure air is essential for a man. Always, therefore, keep at least 2 to 3 windows in a house. Do not tie the cattle in the same house in which you live. Make a separate shed for them. Put the manure away from the house in pits. Do not allow any water to stagnate round about the house. Take away all water used for bathing, cooking, etc., through a channel in which kerosene or phenyle must be added from time to time.

(3) *Clean roads* :—All the roads in the village must be kept quite clean. Never throw any dirt on a common road, but always collect it at one place and then put it into a manure pit.

(4) *Good food and pure milk* :—Great care should be taken in selecting a wholesome and proper diet. Injurious vegetables and meat of animal suffering from infectious or acute inflammatory dieases, must be avoided. Green vegetables must, before eating, be carefully selected and washed Milk from diseased cattle should never be taken. Milking cattle should be washed clean before milking and the milk not exposed to foul air. Milking pails, etc., should be quite clean.

(5) *Personal cleanliness*: -Most of the diseases are caused by small minute germs which are invisible to the eye. It is therefore necessary to take every precaution to keep away from these injurious germs. To avoid this, always take good food and water, wash your body every day, do not approach a man who is suffering from an infectious disease, and use clean clothes. In short the villagers must be advised to take the following precautions, to maintain good sanitation and health :—

(1) To construct their houses on a raised plinth with sufficient doors and windows and high roof;

(2) To keep their houses neat and clean by sweeping not only the inside area, but also the surroundings;

(3) To remove all sweepings and rubbish to a manure pit away from the house, to keep cattle at a distance from the living room ;

(4) To take bath daily and to use clean clothes;

(5) To keep kitchen and utensils clean;

(6) To keep food materials protected from infection;

(7) Fill up all the stagnant pools near habitation;

(8) To take extreme care to protect their sources of water supply from pollution.

In addition to the above sanitary precautions, the following personal habits will help the villagers to ensure a long, healthy and happy life :—

(1) Go to bed early and rise early.

(2) Drink at least 2 seers of pure cold water every day.

(3) Eat simple food with plenty of vegetables, and fruit. Wheat bread, and milk are very strengthening.

(4) Masticate your food properly.

(5) Miss the night meals twice a week.

(6) Take proper care of teeth.

(7) Get plenty of sleep.

(8) Practise deep breathing and take some kind of exercise regularly.

(9) Do not worry.

(10) Cultivate a hobby.

(11) Associate with the young.

(12) Avoid liquor, medicine and debt.

Short remedies for the prevention of some epidemics

(1) *Malaria* :—

(*a*) Distribute quinine.

(b) Popularise the use of mosquito-nets.

(2) *Cholera* :—

(*a*) Insist on disinfecting wells with permanganate of potash.

(*b*) Segregate patients and take precautions for disposal of the excreta.

(3) *Small-pox* :—

Popularise vaccination and re-vaccination.

(4) *Plague* :—

(*a*) Undertake rat killing campaign.

(*b*) Encourage evacuation and inoculation.

Village Dispensary

In every village there must be a dispensary having common medicines for simple treatment. The man in charge of the dispensary must take all possible care at the time of epidemics, to check them. The dispensary should be maintained by the local village panchayat.

In this way if all the above-mentioned measures are taken, to maintain good sanitation and health, in a few years our villages will be seen with better people, and enjoying sound health.

Chapter XIII

Cottage Industries

Under the present circumstances our agriculturist is in great need of some spare time industry. The amount of spare time at his disposal varies greatly according to the local agricultural conditions, but it is estimated, as a broad generalisation, that a large majority of cultivators has at least from two to four months absolute leisure during the year. The problem is how the villager can best utilize this spare time. It is suggested that well-to-do people in the village should think out this problem and consider whether there is any scope for starting a new industry or developing the existing ones. It will be asked whether in these days of cheap mass production by machinery, home industries have any chance of success.

But in even industrially advanced countries like England, Germany and Japan home industries are thriving side by side with manufacturing industries and therefore in India which is traditionally a country of home industries conducted through individual or family effort, cottage industries should have a good future. The only point is that the selection of the industry to be undertaken should be carefully made. The following are some of the points to which attention should be paid before selecting a new line.

1. The raw materials required for the industry should be produced locally in plenty and cheaply.

2. The product of the local manufacture should be from the raw material for big manufacturing industries, namely tanned hides for leather factories, boiled linseed oil for paints and varnishes, etc. Or the product of local manufacture may be a food stuff, *e. g.*, chutnies, sherbats, pickles, etc.

3. The product should be capable of being made on a small scale without the installation of high priced machines.

4. There should be local demand for the products, so that marketing and transport difficulties may not arise.

5. The produce should have a ready market so that much capital may not be locked up in allowing credit.

Some such industries which offer a great scope when developed on right lines are given below:—

1. *Hand Weaving*:—Of all the village industries, hand-loom weaving is the most important in several provinces. The appliances used are of very old type and therefore the output of work is very low It is therefore recommended that by the use of the following improved appliances the weavers can increase the output by 75 per cent, *viz.* (1) Fly shuttle sley, (2) Tappet dobby, (3) Lattie dobby, (4) new kinds of shuttles and perns and warping and sizing appliances. For improving the weaving industry in villages it is not only necessary to increase production by improved machinery, but also to introduce new patterns to suit new tastes. As regards the importance of this industry Mahatma Gandhi says, "It is prominently suitable as a remedy for India's present economic distress." He summarizes the advantages of the '*Charkha*' as follows:—

1. It is immediately practicable, because
   (*a*) It does not require any capital or costly implements to put into operation. Both the raw material and the implements for working it can be cheaply and locally obtained.

(*b*) It does not require any higher degree of skill or intelligence than the ignorant and poverty-stricken masses of India possess.

(*c*) It requires so little physical exertion that even little children and old men can practise it and so contribute their mite to the family fund.

(*d*) It does not require the ground to be prepared for its introduction afresh, as the spinning tradition is still alive among the people.

2. It is universal and permanent, as, next to food, yarn alone can be sure of always commanding an unlimited market at the very door-steps of the worker, and thus insures a steady and regular income to the improverished agriculturist.

3. It is independent of monsoon conditions and so can be carried on even during famine times.

4. It is not opposed to the religious or social susceptibilities of the people.

5. It provides a most perfect ready means of fighting famine.

6. It carries work to the very cottage of the peasant and thus prevents the disintegration of the family under economic distress.

7. It alone can restore some of the benefits of the village communities now well-nigh ruined.

8. It is the backbone as much of the hand-weaver as of the agriculturist, as it alone can provide a stable and permanent basis for the hand-loom industry which at present is supporting from 8 to 10 million people and supplies about one-third of the clothing requirements of India.

9. Its revival would give a fillip to a host of cognate and allied village occupations and thus rescue the villages from the state of decay into which they have fallen.

10. It alone can ensure the equitable distribution of wealth among the millions of inhabitants of India.

11. It alone effectively solves the problem of unemployment, not only the partial unemployment of the agricul-

turist, but of the educated youth of to-day wandering in search of occupation.

2. *Dyeing*:—To-day there are many people in villages who are already carrying on this industry. At present there is not much competition in this business and they are earning a fairly good profit. Therefore this can be followed by some of the other villages.

3. *Durrie and Carpet Weaving*:—Carpet weaving largely carried on in the U. P. and the Punjab and other Provinces too have fairly big establishment in certain centres. The dyeing of yarns is generally done locally, using cheap dyes. The prime need is improving the quality of the local products by using better materials and adop'ing better dyeing methods.

By employing improved fly shuttle sleys, and by improved sleys for fancy patterns in durrie weaving the cost of production can much be reduced. In this industry a skilled workman can easily earn about Re. 1 a day. The initial capital needed for the industry is not more than Rs. 500 and may be carried on a co-operative basis.

4. *Niwar and Rope Making*:—There is a considerable scope for developing both of these industries. There is a good demand for niwar and there is no competition from the mills. But in order to make niwar making a lucrative trade, improved implements must be used Government has introduced two types of niwar sleys each of which is a capable of weaving 6 rows of niwar at a time. The simplest of the two costs Rs. 25 only. The work of making niwar is very simple and can be learnt easily. People living near cotton mills can purchase waste cotton yarn from the mills and utilize the same for making cheaper varieties of niwar.

At present rope making is carried on only for domestic requirements and to provide work during leisure hours. About 50 per cent of the rope required is imported from outside. As several provinces abound in fibres of different kinds such as cotton, ambadi, san, and other grasses, there is no reason why rope making should not be developed. Government has introduced improved varieties of hand winders at Rs. 2 and rope twisting machines at Rs. 25.

5. *Pottery*:—This is one of the most important old industries in our country. It can be easily improved by replacing the crude wheel by a treadle driven wheel of the improved pattern. Other improvements necessary are the improvement in backing and the use of salt glazing.

6. *Soap Making*:—With the advance in civilization the use of soap is increasing rapidly and there is yet considerable scope for the development of this industry. When properly organised it also leaves a fair margin of profit. With the initial outlay of Rs. 500, the earnings are estimated to be Rs. 50 per month, if the industry is started near a growing town The process of making soap is very easy, and can be learnt without any difficulty. However, the preparation of toilet soaps is not suited for cottage workers, still they can very easily prepare bar soaps.

7. *Preparation of Pickles and Morabbas*:—As fruits and vegetables cannot be obtained in fresh condition all the year round, they are preserved in the form of pickles and morabbas. Throughout the year there is a great demand for these things in any town. The fruits necessary for these preparations are available at very cheap rate in villages They therefore should be converted into pickles and morabbas and sent to the nearest towns.

8. *Preparation of Papads and Sevayas*:—There is a great demand for these things in any town. No doubt the preparations are very simple but the city people do not want to bother themselves with their preparation when they can get them ready at cheaper rate. This is a very good industry for women and may be undertaken in any village. These articles should be neatly packed and sent to towns.

9. *Poultry Farming*:—It is also a very good industry which adds to the income of a farmer without much trouble.

10. *Sericulture*:—This industry can be followed without any extra capital outlay and with the least trouble. Castor may be sown in the fields where good crops are not grown, and silk worms reared on it. The oil can be extracted from the seeds and the leaves used for breeding cocoons. One acre of land produces about 8 to 10 maunds of seeds and

120 maunds of leaves which are sufficient to give about 35 seers of silk.

11. *Lac Culture*:—Villagers should also be taught to breed lac insects on pipal, palas, kusum or babul trees. This would also give them an additional income without much expense or labour.

Besides these, there are several other industries, the details of which cannot be given here. These industries are :—

12. Bee-keeping.
13. Embroidery, needle work and hosiery.
14. Preparation of toys.
15. Manufacture of *bidis*.
16. Oil crushing from various oil-seeds.
17. Preparation of furniture.
18. Pencil manufacture.
19. Preparation of various buttons.
20. Drawing and painting.
21. Preparation of mats and baskets.
22. Preparation of *patravalis* and *drons*.
23. Preparation of *amsul* from unriped mangoes.
24. Preparation of various sweets from fruits.
25. Preparation of jellies and syrups.

Out of these industries any one may be taken to suit the local conditions and carry it on a co-operative basis. The products should be sold through the Co-operative Marketing Society which will have its central Marketing Society in towns. In this way the income of our agriculturists will be increased.

Chapter XIV.

SUMMARY AND CONCLUSIONS.

If every Indian village tries to copy the work done in this village, our villages will soon be much improved. There is much scope for further improvements in the village as for example introduction of cottage industries, vocational education, etc. All these possible improvements are given in Part II which gives a complete scheme to make our villages highly organized and model ones. Organizing villages, for their social, political and economic improvement is not an easy task; there are numerous difficulties in the way, one should not therefore be discouraged, if he fails in his first attempt. Our villages have been growing in the darkness of ignorance and have been overpowered by centuries of superstitions and customs.

Before starting any programme of rural reconstruction, it is better to have a thorough knowledge of the existing problems and their solution. This training can very well be got from the Sriniketan of Tagore. This institution is a non-political private organisation and has the support of the Government and sympathy of the people. It is also non-sectarian; and its doors are opened to all, irrespective of their affiliation with any organization, religious, offiicial or non-official.

In this work of rural reconstruction, followers are not wanted; what is really needed is good leadership. The people have to be protected from self-made and self-seeking leaders, who are out to gain their own personal ends and who have not the interests of the village folk at heart.

Real leadership not only requires good training but also a spirit of sacrifice. We need people who will work not for gain or fame, but for the sake of their country. India has been a land of saints and mystics, a land where renunciation has found favour, even with kings and princes. Some of the greatest leaders,—political, religious and social,—have been recognized as such from their life sacrifice and renunciation. The age for renunciation has not passed, nor shall it ever;

it is in the very heart and soul of the people. We have an outstanding example of this renunciation and leadership in that great man, the uncrowned king of the millions of India, Mahatma Gandhi, who has never done anything for the sake of gaining name or fame. Name and fame just came to him ; he could not get away from them. They did not turn his head in any way ; on the other hand, they made him more humble, and gave him strength to go further and further in his sacrifices.

There are a host of others whose names are on the lips of every Indian, and a still greater number of people whom the world does not know and who will never see their names in print, but who are silently sacrificing their lives in the service of their country.

In order to produce such leaders there have to be greater leaders at the Institute itself, that is not merely people with a high sense of duty and with a spirit of service and self-sacrifice, but people who, through their personal lives and example, would inspire young men to take up the cause of the millions who need their help and guidance.

When such leaders will be available in large numbers, our villages will be in a few years on the path of progress. No doubt our villages have enjoyed the most glorious civilization in the past, but to-day the conditions have changed and we must also therefore change the angle of our vision, if we want to keep pace with Western countries.

To the people who ask about the improvement of the villages, the work done in this village will serve as a guide. There is ample scope for the improvement of our villages which can be seen from the activities of the various societies in the village. Improvement in the economic condition of the people of this village is due to the circulation of capital of the various societies. This can be very well seen from the first year's working of the 'Kisan Stiti Sudharak Sanstha.' On the capital of Rs. 573, the society earned a net profit of Rs. 745 in only one year. By this time the society has accumulated a capital of Rs. 14,000.

The key-note to the progress of the village is the wonderful form of co-operation amongst the villagers. However, with all these activities and improvements in the village, we are far from the ideal which we want to reach, but still under the present circumstances the work done is much and needs to be followed by every village. We cannot expect a sudden improvement, we must rise step by step. The problem of water supply is a great hindrance in the further improvement of this village This is a natural calamity and nobody can help to remove it completely. Due to this deficiency of water the farmers cannot grow vegetables and other garden crops on which largely depends the future economic prosperity of India.

The hand-in-hand working of the 22 societies in the village gives us a complete idea of the highly developed form of co-operation which can be introduced in any village. In the end it is therefore hoped that the careful study of this humble contribution will show some pathways to village uplift which is the crying necessity of the country. The recommendations I have made, may be found helpful to all those interested in these problems. They are by no means exhaustive, and if they are found to be of least assistance, I shall feel that my study has been successful in attaining its purpose.

ERRATA

Article—"*Crop Improvement by Breeding For Disease Resistance*" *by M. P. Singh, M. Sc.*

Page 289, Para 2, Sentence 2 "The infection takes place............soil or air."

Delete 'either' and 'air.'

Third sentence on the same page "The infection......... wound or stomata."

Delete 'either through a wound, or stomata' and insert 'through the roots.'

ARTIFICIAL BREEDING*

By

E. J. Perry

Extension Professor of Dairy Husbandry at the New Jersey College of Agriculture.

An editorial in the December 14 issue of Pennsylvania Farmer conveys the thought that artificial breeding may be of doubtful value to stockmen. First of all it should be understood that there is nothing magical about this system of impregnating animals. It merely consists in using mechanical means to place the semen, or sperm carrying medium, in the fore part of the vagina, or in the cervix, or even in the uterus of the female. There is nothing magical about the procedure, or about artificial breeding associations. Artificial insemination is intended primarily as a tool by which the use of the very best sires can be multiplied It makes possible the biggest practical applications of genetics.

Hundreds of large dairy breeding establishments are now practising artificial breeding entirely or in part. Among these as examples are the Pabst Farm of Wisconsin, Carnation of Washington, Maytag of Iowa, and Walker Gordon of New Jersey. Why?

The Reasons

(1) Because fewer but better bulls can be used. Two years ago Walker-Gordon Farm was keeping 46 bulls for its 1,700 cows and heifers. Today it keeps 15 and only because four breeds are on hand is it necessary to keep this number.

(2) Because it enables a breeder to mate a young sire to a number of cows quicker than by the natural method, thus proving him at a younger age.

*Borrowed from The Pennsylvania Farmer, March 22, 1941.

(3) Because a bull's fertility can be fairly well checked by microscopic examination of semen before it is used.

(4) Because there is less likelihood to spread certain infections from cow to cow than by the natural method.

(5) Because large full grown sires can be mated to heifers with no danger to the latter.

(6) Because bulls can be preserved longer in heavy service. With the discovery of the egg yolkphosphate dilutor, semen from healthy bulls can be kept in a fertile state for three to six days when maintained at a temperature of 40 to 46 degrees Fahrenheit. If large breeding establishments find it profitable to practise artificial insemination, properly organized groups of dairymen will also find it profitable.

After two and three-fourth years of experience with five artificial breeding associations in New Jersey, the writer can say frankly that in his opinion the successful achievements of the project have far outweighed some of the disappointments that have arisen from time to time. The possibilities of the programme have been amazing and it is limited in its scope only in proportion as extraordinary bulls of breeding and health are available for use, and healthy herds are enrolled in the association. For instance more than 3,000 cows became pregnant to four proved bulls in less than two years time. But this is not a programme that should be started hastily in any country or district. Only when extra good sires have been "spotted" and a large group of men want the use of them and their kind, should an organization be perfected.

Word received from Denmark before the German invasion last year, indicated plainly that artificial breeding associations were being organized carefully in that great dairy country, and were being accepted as a permanent part of the herd improvement programme. What the status of this work is there at present is not definitely known.

There is no doubt but that the wide co-operative use of our best bulls would reduce much of the present gamble in cow yield. We need fewer but better cows. One-third of

those standing in our stanchions today are non-profit cows, if any labour is figured in. Only one bull out of every three proved raises herd production at all, most of them very little. If you average up the yield of the daughters of the many hundreds of bulls proved in our country's Dairy Herd Improvement Associations last year, and then average the yield of the dams of those daughters, you will find that there is no gain for the daughters. The breeding policy of 98 per cent of the dairymen is to buy a young bull and breed him to all of the cows in the herd for two or three years and then sell the bull when he is grown out. He is sold

(1) to avoid inbreeding.

(2) because he is more bothersome to handle than a young bull, and.

(3) because he will bring a fair price for beef.

Sadly, however, the first few freshening daughters of so many of these bulls show that they are unsatisfactory. But what can the owners do? They feel that they cannot afford to dispose of all of offspring of a poor bull. It is dangerous procedure to "put all of the eggs in one basket". In a breeding association a herd will get the services of several bulls in the course of three years. Some will help and some will hurt production but by using 40 to 60 per cent proved sires, the chances of improving a herd are excellent. One of the main purposes of the breeding associations is to help to drive out the "stock-yard" bulls,—those that are sold cheaply or loaned by some cattle dealers. Such bulls usually have no records of milk and fat test to recommend them.

Experimental Results

Given the same bulls and the proper technique, the percentage of successful pregnancies by the artificial and by the natural method of breeding will usually run about the same. This has frequently been proved experimentally, notably on the island of Samso in Denmark and at the Missouri Experiment Station in this country. It is hardly fair, however, to compare the natural conception rate in herds where young bulls were used with the artificial rate of those

herds after they are enrolled in a breeding association where half of the bulls are usually mature ones. Full-aged bulls will not average to be as sure breeders as young ones, although there are cases in which the fertility of certain young ones is poor and that of some old bulls very good. An average of less than two services or inseminations per pregnancy is considered passably good for cattle of all ages. The rate in the artificial breeding associations of the several states appears to be running close to 1·8.

Of the five associations operating in New Jersey, the largest is Association No 1 in which more than 3,000 cows are enrolled The breeding is done by three full time veterinarians, one of which has charge of the laboratory and the one Jersey, three Guernsey and four Holstein bulls now at the headquarters at Clinton. These quarters were built by the Association and included pens for ten bulls, a combination office and laboratory and a feed storage room. The breeding fee is $5 per cow which covers three inseminations if necessary.

The 30 or more associations such as this throughout the country are semi-experimental. Only by giving them a trial can a measure of their usefulness and practicability be obtained. It appears certain that the practice of artificial insemination will increase. Whether the co-operative phase grows will depend on vari us factors.

It is wrong to believe that only the introduction of certain rules for fixing the price of sugar cane will bring about the desired benefit to the grower or to the consumer. The fixing of price of sugar cane will always be dependent upon the price of sugar and as long as there is no regulated market for the sale of sugar there is no likelihood for the better price of cane."—*Chowdhry Mukhtar Singh.*

"The soil that is now being lost by erosion has taken unbelievably long periods of time to put into its present position. It is now being lost to the value of crores of rupees every year. India through neglect, is losing its birthright."—*Higginbottom.*

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES.

FOR FEBRUARY, 1941.

I—Season.—Some light showers were received throughout the province during the 2nd and 3rd week of February, 1941. There was practically no rain in the remaining period. The rainfall was below the normal in all the districts of the province.

II—Agricultural Operations.—Agricultural operations are generally up-to-date. Pressing of sugarcane, preparation of land for sowing of sugarcane, sowing of extra crops and preparation of gur are in progress. Harvesting of gram, peas and mustard has commenced at places.

III—Standing Crops, and IV—Prospects of the Harvest.—The standing crops are generally satisfactory and the prospects are on the whole favourable. The general estimate of the outturn of *rabi* crops, is expected to range between 80 to 94 per cent. of the normal.

V—Damage to Crops.—Damage from hailstorm is reported from a number of districts, though the loss is negligible.

VI—Agricultural Stock.—The condition of agricultural stock is satisfactory. Cattle disease is reported from certain districts, but the mortality is not high. On the whole, cattle diseases are on the decline as is indicated by the following figures furnished by the Director of Veterinary Services, United Provinces.

Diseases	January, 1941		February, 1941	
	Affected	Deaths	Affected	Deaths
Rinderpest	1,309	693	1,094	740
Foot and mouth	3,761	7	1,214	7
Hæmorrhagic Septicæmia	147	121	171	147

VII—Pasturage and Fodder.—Pasturage and fodder are reported to be sufficient everywhere throughout the province.

VIII—Trade and Prices.—The prices of the chief food grains have fallen slightly. The following figures compare the retail prices in rupees, per maund at the end of the month with those of the previous month :

			End of January, 1941	End of February, 1941
Wheat	...	...	3·736	3·676
Barley	...	...	2·549	2·398
Gram	...	...	3·209	2·879
Rice	...	...	4·982	4·762
Arhar dal	...	...	4·100	3·806

IX—Health and Labour in Rural Areas.—The condition of labouring and agricultural population is generally satisfactory. Plague and small-pox are reported from a few districts.

For March, 1941.

I—Season.—But for some light and scattered showers in the 2nd week the month of March was practically rainless. The rainfall was far below the normal throughout the Province.

II—Agricultural Operations.—Harvesting of rabi crops and pressing of sugarcane continue. Preparation of land for and sowing and irrigation of extra crops and sugarcane are in progress. Agricultural operations are generally up-to-date.

III—Standing Crops and IV—Prospects of the Harvest.—The condition of the standing crops is generally satisfactory and the prospects are favourable on the whole. The outturn of mango is expected to be very poor in the eastern districts of the Province, where it is estimated between 2 to 10 annas in the rupee. In the western districts its outturn is estimated at 12 to 16 annas in the rupee. The average outturn of Mahwa is estimated at about 13 annas in the rupee.

V—Damage to Crops.—No serious damage to crops is reported

VI—Agricultural Stock.—The condition of agricultural stock is satisfactory. Reports of cattle disease have been received from certain districts. There has been a remarkable decline in cattle diseases, except in foot and mouth, over the previous month's figures as is evident from the following figures furnished by the Director of Veterinary Services, United Provinces:

Disease	February, 1941		March, 1941	
	Affected	Deaths	Affected	Deaths
Rinderpest	1,094	740	510	339
Foot and mouth	1,214	7	4,944	41
Hæmorrhagic Septicæmia	171	147	58	49

VII—Pasturage and Fodder.—Pasturage and fodder are reported to be sufficient throughout the Province.

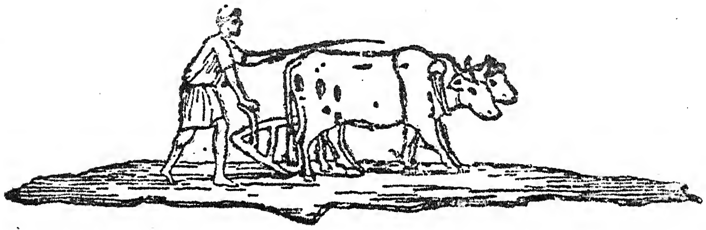
VIII—Trade and Prices.—The prices of the chief food grains have fallen slightly except in the case of rice which shows a slight increase. The following figures compare the retail prices, in rupees per maund, at the end of the month with those of the previous month:

	End of February, 1941	End of March, 1941
Wheat	3·676	3·494
Barley	2·398	2·226
Gram	2·879	2·735
Rice	4·762	5·094
Arhar dal	3·806	3·651

IX—Health and Labour in Rural Areas.—The condition of the labouring and agricultural population is generally reported to be satisfactory. Plague, small-pox and cholera are reported from a few districts.

THE

ALLAHABAD FARMER



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Editorial

The Marketing of Milk

Another very useful report has been put out by the Government of India; and this time it is on the marketing of milk.

The report, 302 pages in all, deals with the milk supply in the country; quality; utilisation and demand; prices; collection, treatment and distribution; methods of transportation; the problem of co-operative marketing; and proposals for the reorganisation of marketing.

On the question of supply the report points out that the number of cattle in this country is approximately 230 millions or about a third of the world's population of cattle. It also points out that India possesses as many milch cattle as the whole of Europe including Russia. But the total production of milk is only about a fifth of that of Europe. India produces less milk than Germany although it possesses six times as many cattle. From these facts one would be led to believe that the breeds of Indian cattle are very poor. That however does not seem to be quite true as some breeds

of Indian cattle are quite good. The average, however, is so poor because of the very poor yield of some of the poor breeds and because of poor feeding. One redeeming feature of the Indian cow is that its milk is richer than that of most of the European cows. In fact she-buffaloes in this country are better fat-producers than some of the best cattle in other countries. Thus, whereas the annual production of butterfat of a she-buffalo in the Punjab is 162 lbs., the annual production of butterfat of cows in Canada is 121 lbs., and in Australia 131 lbs.

So, in spite of the enormous number of cattle in this country, the *per capita* consumption of milk in India is about the lowest, being only about 6 ounces per day. In other countries people consume more than five times this quantity. However, since the average fat percentage of the milk from Indian cattle is more than 6 per cent, an average which is obtained by taking buffalo and goat milk into consideration, the Indian *per capita* consumption of milk, when compared with the consumption of milk in other countries whose fat percentage is about 3·8 per cent, comes to about 10·4 oz. per day. Even then this adjusted figure compares very poorly with averages in other countries, such as Canada (56·8 oz. per day), New Zealand (55·6 oz.), Switzerland (49·2 oz.), Finland 45·4 oz.), Australia (44·4 oz.), Netherlands (44·2 oz.), Norway (41·7 oz.), Great Britain (40·7 oz.), Denmark (40·3 oz.), U.S.A. (35·6 oz.), and Germany (35·0 oz.) This food, therefore, which is said to be the most perfect single food for mankind and which is also considered to be ideal for the expectant mother, the infant, the growing child, the adult and the aged is unavailable for the great majority of the people in sufficient quantities.

In spite of this very low yield of milk in this country, it is also pointed out in the report that the total amount of milk produced in the country is 619·8 million maunds valued at over 180 crores of rupees. Of this, 50 per cent is produced by buffaloes, 47 per cent by cows and only 3 per cent by goats. This value of milk is approximately twice the value of the wheat produced in this country. Milk is therefore a very important agricultural product of India.

But the importance of the milk industry is not to be judged only by its economic value. As milk supplies some of the proteins of which the Indian diet is deficient, so the dairy industry is of considerable importance to the country and deserves a great deal more attention than it has received in the past.

The report points out that the most rapid method of increasing the milk yield in the country is by proper feeding and proper management of animals. It is pointed out that by proper feeding and proper management the yield of Indian cows that have been brought from the villages to Government farms has been increased by 50 to 60 per cent; and in the case of buffaloes their milk yield has increased by about 20 to 25 per cent. The development of the oilseed crushing industry is believed to help in the direction of increasing the milk yield as this results in large supplies of oil cake being available for cattle feeding. At present Indian cattle get on an average 7 lbs. of oil cakes per head per month (*i.e.* less than 4 oz. per day) as compared with European cows which receive 58 lbs. per head per month or nearly 2lbs. per day.

India at present imports milk and milk products such as butter and cheese to the extent of 8 million rupees, although she also exports butter, casein and ghee to the value of about four million rupees.

On the question of utilisation the report points out that the most important factor which limits the *per capita* consumption of milk is the *per capita* income of the people. As is the experience in other countries, families having the least income consume the smallest quantity of milk or milk products, and the consumption proportionately increases with the family income until it reaches a certain point. This fact has to be borne in mind in every "drink more milk" campaign. But even in the matter of propaganda India is very much behind some other countries. There is at present almost nothing in this country to guide the people in spending their money on those articles of food which give them the maximum nutrition.

The daily *per capita* consumption of milk is reported to be highest in Sind with 22·0 oz., followed by the Punjab (19·7 oz.), Rajputana (15·6 oz.), Central India (11·6 oz.), North-West Frontier Province (10·5 oz.), the United Provinces and Delhi (7·8 oz. each), Bihar (6·1 oz.), Kashmir State (4·5 oz.), then Mysore, Madras and Nizam's Dominions (3·6 oz. each), then Bombay Presidency (3·3 oz.), Bengal (2·9 oz.), Orissa (2·5 oz), and Assam (1·2 oz).

As there is practically no inter-provincial trade in fluid milk, and the trade in milk products is also negligible, the consumption in an area mainly depends upon the local supplies and density of population. It is observed that areas which possess better quality dairy cattle and produce more milk, have a higher rate of *per capita* consumption.

The report also points out that the average consumption of milk in cities and towns is almost twice the average consumption in the rural areas. This is due, as has been mentioned above, to the earning and purchasing capacity of the people in cities and towns and also to the better facilities available for the purchase of milk.

Of the various usages of milk in India, the use of milk as ghee is the most important, this being about 58·0 per cent of the total amount of milk produced in the country. Fluid milk is consumed to the extent of 27·3 per cent of the total production. Other uses of milk are *khoa* (5 per cent), curd (5 per cent), butter (1·6 per cent), ice-cream (0·4 per cent), cream (0·3 per cent) and other products (2·4 per cent)

On the subject of milk prices the report points out that the milk producers in this country receive on an average about two-thirds of the price paid by the consumer and that from data collected at Government farms, it appears that milk producers do not always get a fair price from collectors and other intermediaries. On the other hand the share of the Indian producer in the price paid by the consumer is greater than that of the English farmer. Yet milk production is not a profitable business and, in some cases, Indian producers may be selling milk even below cost price. This, says the report, is a matter of utmost importance and requires close examination and thorough study.

In dealing with the subject of collection, treatment and distribution of milk, the report points out that whereas in other countries, these tasks are handled mostly by co-operative dairies, in this country the dairy industry remains in the hands of petty dealers who possess limited means and a narrow outlook. It is also principally dishonest competition from them which has hampered the growth of dairy farms and other large scale organizations in this country. Other less important reasons for the failure of dairies in this country are probably the lack of business experience of managers and failure on the part of consumers to appreciate quality.

On the question of transportation of milk the report points out that at present only 6 per cent of the total milk produced in this country moves over a distance of more than 10 to 15 miles. Only in the case of a few large cities, the distance travelled extends to about 50 miles. In order, therefore, to promote long distance transport of milk, the report recommends the revision of freight rates and the provision of refrigerated facilities on the train. At present even for a distance of 250 to 300 miles the cost of freight amounts to about 55 per cent of the value of milk.

On the subject of the quality of market milk the report has very startling things to say. It reports that bacteriological examination of market milk at Bombay showed that it had more than 36 million microbes per c.c. It also points out that even the sewage effluent of London shows only 11 million microbes per c c. which is less than a third of what the bazaar milk in Bombay contains. In the same place, that is in Bombay, fresh milk drawn in sterilized containers after thoroughly scrubbing and washing the flanks aud udders of the animals with antiseptic lotion showed less then 275 microbes per c.c. Farm-produced raw milk at Bangalore contained 225,000 microbes per c.c. before pasteurisation, but after the process it showed only 9,400 microbes. In other countries raw milk that is "certified" has less than 30,000 microbes per c c. Milk with 20,000,000 microbes per c c. is considered "very bad" according to European and American standards. This and

the subject of adulteration of milk require more careful investigation, and the enactment of proper legislation that can be enforced.

On the subject of reorganization of milk marketing, the report makes two rather startling recommendations:—(*i*) to purge urban areas of all milch cattle, and (*ii*) to entrust the marketing of milk in a city or town to one properly constituted milk marketing organization. If the latter is to be adopted it will probably require special legislation empowering provincial governments and through them the municipal authorities to put such a scheme in operation.

In conclusion we would say that suggestions for improvements, made in the report, will, if they are adopted, promote the well-being and considerably increase the cash returns of many millions of milk producers in the country. The report is particularly commended to municipalities one of whose important functions is to attend to matters connected with milk supply.

A SONG ON COMPOST

Adapted from

"Microbes by the Million"

BY

HUGH NICOL

They all go to compost, to compost, to compost;
They all go to compost, to compost in the end.
Old hats and boots and braces,
My lady's silks and laces -
Just turn 'em into compost, and dump 'em on the land.

We all go to compost, to compost, to compost;
We all go to compost, to compost in the end.
And when our time is ended
And life in us suspended:
We'll all go to compost, to compost in the end.

Tune:—THE KEEL ROW.

PLOUGHS

By

J. C. Barpujari, B. Sc. (Ag.)

Ploughing is recognized as the basic tillage operation by which the soil is loosened and aerated and a layer of soil inverted, covering vegetation and other organic matter. Where such material is to be covered, ploughing, as compared with other methods of soil tillage, is indispensible. The plough antedates history and is therefore one of the oldest agricultural implements.

We can say that the plough is the foundation of civilization, the first step in which was made by man by tilling the soil with the help of a crooked stick. Since then with each step in the development of the plough there has been a corresponding development in civilization.

The types of ploughs used in the varying soils must be adapted to the soil. The mouldboard ploughs are generally used in sandy loam, loam and clay loam soil; specially where the soils are new and have an abundance of humus. Clay soils are often ploughed with disc ploughs. The general purpose bottom is used in the lighter soils which requires low pressures between the soil and the mouldboard for scouring.

Some loams and clay loams will not scour with the general purpose bottom resulting in the use of the quick turn, short stubble mouldboard bottom. The mouldboard of this plough is so designed that the pressure of the soil against the mouldboard is high, thus causing the board to scour. The area of the board is less, reducing the resistance between the soil and the board. In many of the clay loams and clays where the plough share penetrates the soil satisfactorily, and it is desirable to use the mouldboard plough the flat mouldboard stubble bottom is used.

In many clay soils it is impossible to use the mouldboard type plough because of its failure to scour and diffi-

culty in penetration. In such soils a disc plough can be used. The disc plough cuts from eight to twelve inches in width of cut which makes it possible to penetrate very stiff clay soils.

The requirements of a properly designed plough are:—(1) That the furrow slice be cut in such a way that all roots are severed, (2) that the soil be pulverized as the furrow slice is turned, and (3) that the stubble weeds and fertilizers be completely covered leaving the surface of the ploughing smooth and uniform.

In general, plough types are divided into two classes: Mouldboard ploughs and Disc ploughs.

Mould Board Ploughs

Iron and steel mouldboard ploughs were developed during the last half of the eighteenth and the first half of nineteenth centuries. In its various forms this type of plough has become the most widely used tillage implement.

During the last half of the nineteenth century there was added to the plough a frame and wheels, with a seat for the ploughman. During the latter part of this period, ploughs were also combined into gangs of two or more bottoms. After the farm tractor was introduced, the mouldboard plough was the first implement to the developed whose frame and hitch were adapted to tractor operations. The mouldboard ploughs may be classified in many ways: *e.g.*, according to whether the operator walks or rides, the number of bottoms and their types, and the kind of power used. These may be right-handed or left-handed ploughs, according to the direction in which they throw the furrow slice.

Walking Ploughs:—In this case the operator walks behind the plough in operation. The various parts composing a walking plough are share and mouldboard, and is equipped with a vertical and a horizontal clevis for adjusting the height and spread of hitch. The suction of the plough cannot be satisfactorily increased by raising the hitch and running the plough on the point. The suction must be increased by re-sharpening the share and lowering the point. Where the share is badly worn re-pointing is necessary.

Special Walking Ploughs—(*a*) *The New-ground Plough*:—This plough is specially designed for ground that has been cleared of brush, leaving the soil well filled with roots. It is built with the idea of simply breaking the surface of the soil and, at the same time, cutting all roots. Its bottom is constructed with the share and mouldboard in one piece. Wheels are sometimes used to take the place of the land-side. It has also a hanging coulter of the knife type to aid in cutting the roots. The beam may be made of either wood or steel.

(*b*) *Reversible Hillside Ploughs*:—These consist of walking ploughs where the mouldboard and share are hinged at the bottom and can be reversed either to the right or to the left. The operator is enabled to make a right-handed plough into a left-handed plough by swinging the plough bottom underneath to the left. They are used in fields where all the furrow slices are to be thrown into the same direction as on hillsides from which they get their name. They are good for experimental plots, irrigated fields and for irregular-shaped fields and corners. No dead furrow is left when this plough is used.

(*c*) *Subsoil Ploughs*:—These ploughs are entirely used to break the subsoil to aid in the retaining of moisture and to give a larger root zone for plants. In these ploughs instead of having a share and mouldboard as in the ordinary walking ploughs these parts are almost entirely done away with. Extending downward from the beam is what is called the standard which is made of steel. The front edge of this standard is sharpened, making a heavy knife. The shoe is attached to the bottom of the standard. This shoe is constructed somewhat on the order of a small share which has considerable vertical suction. The walking type of subsoil plough is used in the bottom of the furrows behind the ordinary type of walking plough. This allows the subsoil plough to penetrate deeper, loosening the subsoil beneath the furrow slice.

(*d*) *Middle Breaker*:—It is constructed with two mouldboards, one for turning the soil to the right, the other for

turning it to the left. The share is a double wing affair to take care of both the right and left boards. This plough instead of having a landside, has what is called a rudder, which acts in about the same way as a landside on an ordinary walking plough. There is a knife or rudder blade attached to the bottom of the rudder which cuts down into the soil and prevents it from dodging to the side. This plough is used in between the rows of crops, hence the common name Middle breaker. In semi-arid sections where the crops are planted in the bottom of the furrow it is called a lister. The same tool may be used in an irrigated area for opening up ditches, hence it is also called a ditcher.

(*e*) *Vineyard Plough*:—The Vineyard Plough is a special built plough working in vineyards where it is necessary to plough close to the vines, yet, at the same time, prevent the handles from injuring the fruits and foliage. The handles on this plough are adjustable to the side to allow such work to be done.

Riding Ploughs:—The riding plough is carried entirely upon well lubricated wheels. The front furrow wheel acts as a gauge wheel. The rear furrow wheel supports the back of the plough while the land wheel keeps the plough level. The thrust due to turning the furrow slice is carried by the long landside against the furrow wall in the walking plough. In the riding plough the rear furrow wheel is set, from $\frac{3}{4}$ of an inch to $1\frac{1}{2}$ inch outside the line of the landside, to carry the side thrust.

The three general types of what are usually classed as riding ploughs are sulky ploughs, two bottom gang ploughs, and three bottom gang ploughs, each built in several different styles to meet the requirements of a particular area.

The sulky or one bottom riding plough, was the natural outgrowth of a desire for a plough more easily handled than the walking plough. The sulky plough increases the working capacity and lessens the task of the ploughman. Its advantages are; (1) friction is reduced because the plough is mounted on wheels; (2) the operator is allowed to ride affording greater ease of operation; (3) with the average unskilled

ploughman better work will be done because it is steadier and the adjustment cannot be disturbed easily; and (4) here is a tendency to make the plough take the full width of the furrow at all times.

The two way sulky plough has two bottoms, a left-handed and a right-handed bottom. Only one of them is used at a time: one while going in one direction, the other while returning. This kind of operation throws the furrow slices in the same direction. It is useful and used in condition where reversible hillside ploughs can be used.

Riding Middle Breaker or Lister :—The riding middle breaker is mounted on two wheels, having a seat for the operator. There are levers for adjusting the depth. The general construction and use are the same as in walking middle breakers.

The Steel Gang :—This is a plough constructed entirely of steel to give such strength that it will withstand hard usage and rough soil. There are generally 2 to 3 bottoms. The plough has only two wheels: the furrow wheel and the land wheel, no rear furrow wheel being used. The landside for the rear bottom is extra heavy and takes care of the rear adjustment. It has a long landing lever, a leveling lever and a lifting lever.

Engine Gang Ploughs:—The early type of ploughs with engine gang ploughs was developed in England where a large steam tractor was stationed at each end of the furrow with a large drum pulley on which a cable was wound. One end of the cable was fastened to each drum and the plough in between and it was alternately drawn forward and backward across the field by tractors. This type of plough is still used but it is a rather expensive way to plough due to the large amount of costly equipment necessary. The American idea is to hitch the plough behind the power, and move tractor plough and all, across the field together.

The Power Lift Gang Plough :—This resembles the animal drawn gang plough with the necessary difference in the hitch. In a power lift plough the bottoms are lifted out

of the ground as a single unit; that is, all bottoms being raised at the same time by a special power lift clutch. All of the tractor ploughs are guided and controlled by the tractor.

Chisel Plough:—This is a special type of tractor drawn plough with a special kind of pointed attachment in place of the mouldboard. It stirs the soil thoroughly without turning up the moist subsoil, thus having the dry soil on top. It gives deep cultivation, breaking up hard-pans and plough soles which permit free movement of the soil moisture and the absorption of a large percentage of rainfall.

Power-Subsoilers :—A special tool for deep penetration to break up subsoils or hard pans.

Basin or Damming Lister:—In areas where the soil has a tendency to blow and soil moisture is low, dams are made in the listed furrow with a damming, in which rainfall is stored. The dams are formed with blade shaped to fit into a listed furrow so they will catch soil on the sides and bottom of the furrow. When the blade has moved forward 8 to 10 ft. or enough to fill the furrow with soil it is lifted over the soil, thus forming a dam. Several methods of lifting up the blades or damming attachments have been developed.

Disc Ploughs

The disc plough is carried entirely upon wheels similar to the mouldboard riding plough. The entire thrust of cutting and turning the furrow slice is carried by the wheels. The wheels of the disc plough are customarily given a slope from the vertical thus decreasing the draft of the plough and altering the centre of resistance and line of draft of plough.

Disc ploughs are used in territories where soil conditions are such that mouldboard ploughs will not operate to the best advantage. They work in soils so dry and hard that mouldboard ploughs cannot penetrate, and in sticky soils where mouldboard ploughs will not scour well. They are also used to advantage in very loose ground and in stony and rooty land.

Disc ploughs are built in both tractor drawn and animal drawn types, in styles to meet varying requirements. The number of discs also varies from one to many. The size of the disc varies with requirement. For use with larger, heavier, powerful tractors there are several types of heavy duty and extra heavy duty ploughs designed to do the toughest ploughing jobs encountered.

Types of Disc Ploughs—(1) *The sulky Disc*:—The sulky disc plough as in the case of a sulky mould board plough, has one bottom. The disc plough bottom is a perfectly round, concave disc of steel sharpened on the edge to aid in the penetration of the soil. These discs are set at an angle both to the plough sole and to the furrow wall. This allows the disc to have a sort of scooping action. The use of heat treated disc plough bottoms assures longer life, a smooth cutting edge, and easier penetration.

All disc ploughs should be equipped with scrapers which can be adjusted to work from the centre to the edge of the disc. With the aid of the scraper it is possible to get greater pulverization of the furrow slice. It is also possible to invert the furrow slice better.

The disc plough can be made to penetrate more easily by setting the disc more in a vertical position. The flatter it sets the less tendency there will be for it to penetrate.

(2) *The Gang Disc Plough*:—The gang disc plough differs from a sulky disc plough in that there are two or more bottoms Many of the sulky ploughs are so constructed that they can be changed into a gang plough by adding another bottom making either a two disc or a three disc ploughs. For this reason this type of plough is sometimes called multiple gang plough.

(3) *The special horse-drawn Disc Ploughs*: Reversible disc plough: This plough consisting of one bottom is so constructed that the disc can be reversed and the soil thrown in the same direction at all times.

(4) *The Engine Gang Disc Ploughs*:—Regular tractor Disc ploughs : Tractor disc ploughs may be divided into two classes according to the manner of construction of the frame, the side type and the overhead frame type. The side frame

disc plough is the original design and all the engine disc ploughs were made with this type of frame. The frame fits to one side and below the edge of the disc. The disc plough with the overhead frame has the frame elevated several inches higher so that the disc bottoms can be suspended underneath giving more clearance. In addition, disc ploughs have been designed specially as one way disc ploughs, orchard disc ploughs, etc , whose working is indicated by the name of the plough.

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ETERNAL MYSTERIES

T. Tertius Noble

A fire-mist and a planet, a crystal and a cell,
A jelly-fish and a saurian, and caves where the cave-men dwell;
Then a sense of law and beauty, and a face turned from the clod;
Some call it Evolution, and others call it God.

A haze on the far horizon, the infinite, tender sky,
The ripe, rich tints of the cornfields, and wild geese sailing high;
And all over upland and lowland, the charm of the golden-rod;
Some of us call it Autumn, and others call it God.

Like tides on a crescent sea-beach when the moon is new and thin,
Into our hearts high yearnings come welling and surging in;
Some from the mystic ocean, whose rim no foot hath trod;
Some of us call it Longing, and others call it God.

A picket frozen on duty, a mother starved for her brood,
Socrates drinking the hemlock, and Jesus on the rood;
And millions, who, humble and nameless, the straight, hard pathway plod;
Some call it Consecration, and others call it God.

METHODS OF MAKING JELLIES FROM DIFFERENT FRUITS

By

A. Dayal Chand, M.A., B.Sc. (Ag.), F R. H. S.

1. Roselle Jelly.

Roselle or Hibiscus sabdariffa, which is commonly known as "patwa", belongs to the family Malvaceae. It is an annual plant which is commonly grown in kitchen gardens. Seeds are sown in the nursery from May to July, although the optimum time of sowing seeds in order to get sepals earlier for making jelly is the last week of May. The seedlings, when 6 to 12 inches high, are transplanted giving a space of 4 or 5 feet between plants. Roselle is a very hardy plant and thrives even in semi-arid regions. Under normal conditions the plant grows to a height of 6 to 7 feet and branches profusely forming a fairly thick bush.

Roselle starts blossoming at the end of August or the beginning of September. Its yellow flowers with dark crimson "eyes" soon drop off, leaving a crimson-red calyx adhering closely to the fruit. It is for these large, fleshy and succulent sepals that the plant is grown. These sepals are used for making puddings, chutneys and delicious jams and jellies. The sepals are also dried and kept for making a tart cool drink or for making jam or jelly when roselle is not in season.

The process of making roselle jelly :—Cut off the fruits from the plants when the calyx is fully developed, remove the sepals for use and discard the fruits. Weigh the sepals and wash them thoroughly two or three times in order to remove all the dirt adhering to the sepals. To each part of sepals add two parts of water by weight, and cook it for ten to fifteen minutes until the sepals become quite soft and can be mashed between the fingers. Remove the kettle from the

fire and strain the juice as described for guavas (see previous articles by the same author in the Allahabad Farmer.)

Take three pounds of juice in a kettle, put it on the fire, and when the juice starts boiling vigorously, add three pounds of crystalline sugar and dissolve it by stirring. The juice ceases to boil on addition of sugar; and on reboiling, a thick film of organic matter rises to the surface which should be skimmed off with a spoon before the juice begins to boil again. Remove the kettle from the fire and strain the juice because it has been observed that no matter how pure the sugar may be, there always exist impurities which stand out as black speck when the jellies are poured in glass jars, and which make the product unpleasant to look at. The juice is put back on the fire and cooked rapidly to jelling point, which is determined in the same way as explained for guava jelly. If the above process is followed closely, roselle jelly jells between 220 to 222 F. When the cooking is finished, the boiling hot jelly should be poured into sterilized hot glass jars or tins and sealed :—

Precautions :—(*a*) Roselle is rich in both acid and pectin, therefore equal amounts of sugar have been found adequate and economical as it is evident from the following table :

Amount of Juice	Amount of Sugar	Temperature	Out turn
3lbs.	$3\frac{1}{2}$lbs.	220 F	$4\frac{1}{4}$lbs.
3lbs.	3lbs.	220 F	4lb.
3lbs.	$2\frac{1}{2}$lbs.	220 F	$2\frac{3}{4}$lbs.

(*b*) Not only less jelly is obtained when less sugar is used, but the product becomes tough or leathery, tastes tart and does not keep well.

(*c*) Roselle jelly cooked on a slow fire tends to become dark and leathery, therefore it should be cooked rapidly on a strong fire.

(*d*) Although it is a general practice to make roselle jelly from sepals only, it is found that jelly made from the whole fruit has a better taste and retains its flavour better than jelly made from the sepals only. But there is one difficulty in using the whole fruit. The calyx being firmly attached to the fruit cannot be washed thoroughly and also borers which are sometimes found in the fruits cannot be detected unless great precautions are taken. When whole fruits are used for making jelly a double amount of water should be used for extracting the juice.

(*e*) It is also found that if the calyxes (or calices) from immature fruits are used for making jelly, their juice either does not jell or it produces very thin syrupy jelly having very poor flavour. It is very necessary therefore that for producing the best jelly the fruits should not be used until they are properly mature. Immature fruits may be used for making jam, pudding, etc. It has also been found that towards the end of the season the juice of roselle becomes weak in pectin and acid, therefore, if the same amount of water and the same proportion of sugar are used, the juice fails to jell. So in order to make good jelly the proportion of water for extracting juice, and also sugar, should be accordingly reduced.

(*f*) When fresh roselle is not available, and dried roselle is used for making jelly, ten parts of water should be used for each part of dry roselle for extracting juice. Dry roselle is rich in both acid and pectin and give as good a jelly as fresh roselle, if dried before it is over-ripe.

It has been found, however, that before the rainy season, and even during the first half of the rainy season, dried roselle makes a very good jelly, but towards the end and after the rainy season the juice from dried roselle deteriorates in both acid and pectin content and does not jell properly.

Roselle jelly being slightly acid in taste is relished very much.

2. Karonda Jelly

Karonda or Carissa Carondas is a perennial woody plant. It is very hardy but is also very slow growing. The plant requires a little care in the first year, but when once established it grows without care and even without irrigation. It serves two purposes: (1) Due to its drought resistant habits, its small, leathery, glossy leaves, and its thick sharp thorns, it is used as a hedge plant; and (2) It bears fruits which are of commercial importance. From time immemorial the fruits have only been used for making *chutney* and *achar*. Only recently has it been discovered that one of the best jellies can be made from its fruits.

There are two common varieties of karonda. One variety bears green fruits which on ripening turn dark purple, and the other variety bears fruits which either become pink or white with deep pink patches when ripe. The latter variety is very pretty to look at and is often candied. The juice extracted from the green variety is green, but the other variety imparts a very beautiful pink colour to the juice, due to which it is preferred for preparing cool drink and syrup. As regards making jelly, both the varieties yield equally good jellies and there is no difference whatsoever in the colour, taste or flavour of the finished product.

Karonda fruits are ready for making jelly in the middle of July. This fruit, like all others, should neither be immature nor over-ripe when used for making jelly. If immature fruits are used, the jelly will retain a peculiar flavour which is not appreciated, and if over-ripe fruits are used, the jelly becomes dark in colour which does not attract customers. So in order to get excellent jelly, the fruits should be used when they are fully developed and are just turning soft.

Process.—Sort out the fruit, weigh and wash it in order to remove all the adhering dust. Add three pounds of water to each pound of fruit and cook for about twenty minutes until the fruits burst and can be mashed up when pressed by means of a spoon against the side of the kettle. When the

fruit is cooked, crush it by means of a large ladle in order to extract a major part of the pectin and acid. Remove the kettle from the fire and strain the juice as described for guavas.

This is one of those fruits which yields very cloudy juice due to the presence of organic matter which remains suspended in the juice in colloidal form. Many ordinary means are tried to clarify the juice, but none of them seems to work out successfully. Fuller's earth does precipitate the organic matter, but it harms the juice by neutralizing the acid. It is, however, seen that filtering through a felt jelly bag and using a little bit of alum during boiling to clarify the juice gives a reasonably transparent and attractive jelly.

Cooking.—Take a desirable amount of karonda juice, bring it to a boil, remove the scum and then add an equal amount of sugar because karonda juice is quite rich in acid and pectin. Dissolve the sugar by stirring and leave the juice unstirred for a short time allowing the organic matter to precipitate and rise on the surface. Remove the scum and strain the syrup to remove impurities that may happen to be present in the sugar. Start cooking again and add half an ounce of powdered alum, which will precipitate the rest of the organic matter leaving the syrup more or less clear. Keep on taking away the scum as it accumulates, until the jelling point is reached. Determine the end point by the process previously described. Pour the boiling hot jelly into sterilized containers and seal.

This jelly usually jells between 220° to 222°F. It resembles apple jelly and is highly esteemed by many people.

There is but one virtue: to help human beings to free and beautiful life; but one sin: to do them indifferent or cruel hurt; the love of humanity is the whole of morality. This is Goodness, this is Humanism, this is the Social Conscience.—*J. William Lloyd.*

RICE CULTIVATION IN THE SALINE TRACTS OF GOSABA (SUNDERBANS)

By

HARIDAS CHAKRAVARTY, B. Sc. (AGR.)

Sir Daniel Hamilton took the lease of Gosaba Island in the year 1903 when the whole area was covered with jungles and washed day and night with salt water. The soil, at that time, was not at all suitable for cultivation of crops on account of the excessive salt, deposited by the intersected saline rivers. The first problem which had to be solved here, was to check the flow of the saline water into the land. In order to achieve this purpose, embankments were constructed round the island. The embankments here serve two functions—first, they check the flow of saline water into the land and secondly, they control the rain-water according to the requirements of the paddy crops. After the construction of the embankments the area was totally deforested but the cultivation work was not at all possible.

In the first year the whole area had to be washed away by the rain-water. This process helped in washing away the upper layer of salt in the soil.

In the second year also thorough cultivation was not at all possible; because the roots and the cut portions of the stems of the plants were still present in the soil. The cultivators had to transplant the seedlings of paddy in the spaces between those roots and stems. The stagnant water for the transplanted paddy crops helped in the process of rotting of those roots and stems.

In the third year the cultivators could use the country plough to some extent in a zig zag way round those half rotten roots and stems.

In the fourth year the complete rotting of those roots and stems took place and the difficulties were overcome.

The above processes only helped the cultivators to reclaim the land and to use the country plough more

thoroughly for proper cultivation. In the beginning no particular variety of paddy could be grown here successfully. Many varieties grown here, could not resist the excessive salt of the soil and the yield of paddy was only 6 to 8 mds. per acre which hardly met the cost of cultivation. In order to solve this problem about 300 ears were collected from the existing Patnai paddy of the Sunderban saline areas. Those ears were sent to Dacca, the head station of the Bengal Agricultural Department, where 76 varieties were selected and the rest were rejected. At that time in the selection of the varieties more stress was given on the vegetative growth, tillering and on the number of spikelets, but the question of large grains was not yet taken into consideration. Out of those 75 selected varieties 25 was sent to Barisal, 25 to Chinsurah and the rest was kept in the Dacca farm for further trial.

The varieties sent to Chinsurah farm were brought to Gosaba in the year 1933 for the varietal test against the local Patnai paddy. After a thorough varietal test for three years, only one variety proved to be very promising which was named as Gosaba 23 (Patnai).

Gosaba 23 (*Patnai*) is a transplanted 'aman' paddy which requires rich soil and can be grown best on the medium land. It can withstand standing water up to 3 feet. The length of the straw is generally 4 to 5 feet in the medium land but it goes up to 6 feet in the low lands. It has the tendency to lodge but it lodges badly in the low lands. The lodging tendency in the medium land does not in any way affect the yield; but marked difference in yield can be seen if lodging takes place in the low lands In the medium lands it can resist drought to a greater extent, but in the low lands the grains become spotted, the colour of which is brown. The grains are white, long, translucent and polished having no cracks on them. The colour of the husk is whitish yellow. The size of the grains become smaller if it is grown in the excessive saline land. The best time for transplantation in the medium land is in the month of July. Only one seedling is put in at one point and the distance between the two seedlings varies from nine to

twelve inches. It can also be grown in the rich soil of low lands in the month of September when the water in those areas is comparatively less. The yield in this case will be more. Only one weeding is sufficient when the plants attain the height of about two feet. Flowering is completed before the 27th October. Even if the transplantation is delayed the plants will flower within that time. The grains form in the last week of November and the harvesting work is begun from the first week of December. The maximum yield has gone up to 50 mds. and the average is about 30 mds.

Two other transplanted 'aman' paddy grown here in the high lands are selected Rupsal and Dadsal.

Selected Rupsal.—It is considered to be the best, if grown in slightly higher than medium land. In medium land it can also be grown successfully but it cannot compete with Gosaba 23 (Patnai). As regards water requirements, it requires less water and can be grown most successfully in fields having up to one and a half feet of water. It can resist drought even more than Gosaba 23 and it has not got any tendency to lodge The length of the straw varies from 4 to 5 feet. The grains are white, shorter than Gosaba 23, with yellowish white husks, and are medium fine. The best time for transplantation is the beginning of July and better results are achieved if transplanted early. Flowering is completed before the 16th October, and the crop is harvested earlier than Gosaba 23. The average yield goes above 25 mds. per acre.

Selected Dadsal.—This variety has given better results than Rupsal when grown in the same land. It can resist drought more than Rupsal and can be grown most successfully in fields having up to one foot of water. It is transplanted the earliest of all other varieties but flowering is completed by the 16th October and is harvested at the same time as Rupsal. The grains are oval shaped, small and scented. The attack of insects on account of the scented grains causes some damage to this variety. The average yield goes above 20 mds. per acre.

Kumragore.—This variety can be grown in fields having up to four and a half feet of water. It is considered here as

deep water paddy. Generally the seeds are broadcast from the end of May to the beginning of June when the monsoon first sets in. The plants flower in the beginning of November and are harvested in the last week of December. Sometimes harvesting is delayed up to the middle of January until the stagnant water in the field is totally dried up. The length of the straw goes up to 7 feet The grains are white, long and broad. This is the only variety which can be grown here most successfully in deep water. The average yield goes up to 20 mds. per acre.

The annual rainfall here is about 60 inches and the plants receive plenty of water during the period of growth. The excess water, on account of the continuous heavy shower for a few days, can be drained off through the sluice gates which are fitted in the embankments at suitable distance. This is a great advantage due to which paddy can be grown here most successfully.

It can be seen from the above facts that it is not at all difficult to grow crops in the saline tracts without the addition of any chemicals to neutralise thc salt of the soil. Further in my opinion the soil is very rich in nitrogen which helps much in the vegetative growth of the crops. Other varieties are under experiment, and I hope Sir Daniel Hamilton Estate will set an example in growing paddy most successfully in a saline tract like Gosaba.

Don't be afraid of the enemies who attack you. Be afraid of friends who flatter you.– *General Obregon.*

Whatever nation deserves to be called a great country lives by collective sacrifices.—*M. Auguste Detoeuf.*

"Are you quite sure that your milk is pure ?" the suspicious housewife asked.

"Yes mum," the milkman replied. "Its been paralysed by the Public Anarchist."

THE ROLE OF NITROGEN, PHOSPHORUS AND POTASSIUM IN PLANT LIFE

By

V. N. Saxena, B.Sc (Ag.)

Comparative study of the effectiveness of nitrogen, phosphorus and potassium on crops and soils

Some of the earliest agricultural experts of the 19th century had shown, before nitrogen, phosphorus and potassium were much known, that nitrate of soda and sulphate of ammonia gave valuable crop increases.

Liebig together with his other colleagues, had accepted ammonia as the primary nitrogenous food of plants. Phosphorus was shown for the first time to be an essential plant nutrient by Theodore de Saussure in 1804 ; and bones were considered to be very good fertilizers for certain crops.

It may thus be observed that though little was known about the chemistry of agriculture, yet it had its footing in the earlier part of the 19th century.

With the development of agricultural chemistry it was ascertained that plants consist of carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulphur, calcium, iron and magnesium. Of these important constituents of plants the first three are availed of by the plant from the air. The leaves of the plant manufacture starch using air and water in the presence of sunlight. The other set of elements, namely, nitrogen, phosphorus and potassium is however provided by the soil together with all the other mineral constituents.

Various chemical analysis have shown that minerals used by plants are in a very small quantity as compared to nitrogen, phosphorus and potassium. Every crop removes a large percentage of these elements every year, thus leaving the soil comparatively poorer. A heavy loss is suffered by the soil due to leaching and drainage water.

The following table, taken from Raber, illustrates the amount of nitrogen, phosphorus and potassium that is lost in one acre due to one particular crop :

Crop.	Yield.	Plant foods removed per Acre.		
		N-lbs.	P-lbs.	K-lbs.
Wheat ...	30 bushels	42·6	7·2	7·8
Apples ...	400 „	25·6	5·9	41·5
Potatoes ...	200 „	42·0	8·7	60·0

The above table conveys to one an idea about the amount of plant food (N.P.K.) removed from one acre by various crops. From the table, it is clear that nitrogen, phosphorus and potassium are used more commonly in higher quantities in most crops and that the soil continues to be poorer. This reduction in the soil is compensated by the addition of manures or fertilisers in the soil.

The soil is also a very complex aggregate of very many minerals. The agricultural soil can be however separated from the general term soils, to mean the soil on which crops can be and are grown. These soils can be classified into three major heads: clay soils, sandy soils and the loams.

It is nevertheless notable that the amount of the important elements varies in different types of soil and in different regions in response to their origin and their geography.

The following table will show that the amount of the essential plant nutrients present in the soil is very low, and which will be very soon consumed by the plants or removed by other agencies if proper care and addition of the elements will not be maintained.

Percentage of some elements in a sample of soil.

Nitrogen	0·20 p.c.
Phosphorus	0·07 p.c.
Potassium	0·35 p.c.
Calcium	0·60 p.c.
Sulphur	0·06 p.c.

Obviously, even nitrogen, phosphorus and potassium together are less than 1 per cent. of the whole. It should be however borne in mind that this is not all available to the plants in full quantity.

It follows from our discussion above that plants need very large quantities of nitrogen, phosphorus and potassium and that they are essential for plant life. We shall discuss later how and what function is performed by these elements. Also, the soil is incompetent to provide for the plants unless enough supply of these elements is kept in the soil by manuring.

The discussion of these elements as to their use, assimilation, etc , will now be taken one by one to show the task they perform in plant life.

The relative importance of these three elements cannot be disputed. Each has different functions assigned to it and each is invariably a supporter of the other.

NITROGEN

"No elements in respect to crop-production has received so much attention as nitrogen. It is present in the dry matter of plants to the average extent of 1·5 per cent. only, and yet its compounds are of the biggest value in agriculture as well as in commercial industries."—DR. VAN SLYKE.

Functions and effects of Nitrogen :—1. Nitrogen forms a component of all protoplasm and therefore is especially important for normal metabolism.

2. Abundance of nitrogen promotes growth which is shown by the extreme luxuriance of stem and leaf. It is a desirable character in general, because leaf is the great machine to build up the body tissues of the plants; and it is a necessity for all leafy vegetables to provide plentiful yield.

The amount of plant material that can be built up by an additional supply of nitrogen to the crop is considerably high. Lawes and Gilbert showed that 1 lb. of nitrogen supplied as manure adds between 40 to 50 lbs. of dry matter to the crop of cereals, mangolds and sugar beets The increases are more consistent and vary less from soil to soil and from season to season than those given by any other fertilizer.

3. The effectiveness of the nitrogenous manure is sometimes increased by the addition of organic nitrogen. Its effect however varies according to crop, season and management.

4. Studies in the process of flowering seem to show that vigorously growing but unfruitful plants can be made to produce fruits by decreasing the nitrogen supply. It has been, however, noted that cases such as the above depend more or less on the amount of carbohydrates present.

5. Nitrogen tends to inhibit the formation of roots while carbohydrates favour their development.

6. One of the most evident effects of nitrogen is the production of a healthy green colour. The change in colour can be seen almost in 24 hours in favourable conditions.

7. Increased supply of nitrogen increases the efficiency of the plant as a user of water, thus enabling it to manufacture more nitrogenous substances and a proportionate increase in carbohydrates. The mineral and water content of the plant is increased, however, in harmony with other elements.

In favourable conditions the nitrogen enables so much carbohydrates to be produced in the plant that its compounds are overbalanced by it. The excess of nitrogen

which is stored in some form in the plant causes harmful effects, and is found to have intoxicating influence on the plant.

8. High nitrogen content produces such desirable characters as succulence crispness and soft tissues in such crops as lettuce, celery, and other vegetables used for their leaf only.

9. In as much as nitrogen is a desirable element for the production of succulent leaves in leafy vegetables and fodder, it is a menace to certain other crops, as it makes the plant very soft and an easy prey to insects and fungous diseases. Lodging of plants is very commonly attributed to nitrogen.

10. According to Molliard (1922) the respiratory functions in the plants are adversely affected in cases where nitrogen is insufficient.

11. As has been mentioned before, high nitrogen content delays the formation of flowers, hence also the maturity of plants.

Nitrogen in Soils.—Soil nitrogen occurs in three forms, namely,

1. Organic nitrogen,
2. Ammonia nitrogen,

and 3. Nitrate nitrogen.

Complex nitrogen compounds such as proteins are not available for the plants unless they are broken up into simpler compounds such as nitrogen or amino-acids. Whether it is due to the inability of roots to absorb large molecules or to some other cause is not yet understood.

The ammonium nitrogen is not generally used by plants except in the case of rice, or sugar cane in its young stage. The nitrate is the best form of nitrogen which is easily available to the plants.

All types of nitrogen is broken down to the nitrate form which is then assimilated by the plants. Soil organisms play an important role in this respect.

Assimilation:—Proteins are the main products of nitrogen assimilation. The chemistry of nitrogen is not yet quite clear. However it is supposed that amino-acids are the first step in the formation of proteins.

It has been ascertained that nitric salts are absorbed by root hairs whence they penetrate unchanged into the root-vessels and they are transferred in the same state through the vascular bundles up the stem and into the leaves.

Formerly it was the common presumption that the reduction of nitrates to amino-acids was at the direct expense of light. But later observations have shown that in the presence of carbohydrates nitrogen assimilation continues. Hence sunlight is only necessary indirectly in the formation of carbohydrates. Which of the two suppositions is correct is yet an undecided question.

The protein substances entering the nucleus—the nucleo-proteins—are much different from the proteins in seeds. The hydrolysis of these nucleo-proteins can yield simpler substances, some of which are bases like pyrimidine and purine, while acids like phosphoric acid and nucleic acid are formed at different stages of hydrolysis.

Soil nitrogen is lost in various forms and if there were no means of bringing that amount up it would have been difficult to raise crops today. Nature has provided adequate measures for the fixation of nitrogen in soils. It is accomplished by nitrogen-fixing bacteria.

These bacteria are anaerobic and live on non-nitrogenous material. The activity of these bacteria is greatly accelerated by the presence of manures, straw, etc., which thus contribute to the accumulation of nitrogen in soils.

The assimilation of nitrogen by the leguminous plants had for a long time attracted the interest of the scientists. It is now known that the root nodules of such plants are full of nitrogen-fixing bacteria which take up the free nitrogen and make it available for plants.

At the death of a leguminous plant the bacteria leave its nodules but continue to exist in the soil and inoculate the next such crop when grown. The relationship existing between leguminous plants and nodular bacteria is usually regarded as one of "symbiosis", namely an intimate union of two organisms both of which are benefited. The bacteria make use of the carbohydrates from the plant and in turn supply the plant with combined nitrogen.

Deficiency symptoms:—When the physical condition of the soil is good and sufficient rain and sunshine are available, a pale green or yellow colour accompanied with slow growth is commonly an indication for nitrogen-starvation.

Lack of nitrogen will result in poor foliage, stunted growth and a low ratio of straw to grain.

Nitrogenous manures:—In addition to the organic manures as sources of nitrogen, many salts of nitrogen are in use to provide for the nitrogen requirements of the crop.

To take up a full study of the various nitrogenous fertilizers along with their effects on various crops and soils a long discussion is essential. Here we shall just state a few of them with a brief discussion following them.

1. Sodium nitrate ($NO._3$): It contains about 15·5 per cent of nitrogen on an average, and is very widely used in the West. It is easily soluble in water and can be readily utilized by plants. Due to the presence of sodium, it tends to produce alkali in the semi-arid areas. In India, it can be used in the eastern provinces only.

2. Ammonium sulphate ($(NH4)_2SO_4$) : It contains about 21 per cent of nitrogen. It is used more extensively than any other fertilizer. In soils the calcium takes up the sulphate while an insoluble ammonium compound is formed and is later nitrified. It is recommended for sugarcane to be used with farm yard manure.

3. Potassium nitrate (KNO_3): It contains 13 per cent of nitrogen and 44 per cent of potash. It is a double fertilizer but it is used more in explosive mixtures.

4. Muriate of ammonia (NH_4Cl), calcium cyanamide, ammonium nitrate, etc., are other fertilizers very commonly

used. Each has important effects on crops and soils; and a separate extensive study is essential to comprehend them all.

Phosphorus

The value of phosphorus was recognized as early as that of nitrogen. Lawes was the first man to manufacture superphosphates and it was since then (1843) that phosphatic fertilizers were put in common use.

Functions of phosphorus:—1. It occurs in almost all soils and in almost sufficient quantities to provide for crop requirements.

2. It is a very important plant food. In young plants it increases root growth. Hence it is a very good fertilizer for carrots, beets, and other root-crops.

3. Leaf development is hastened when the plant is small.

4. Phosphorus tends to favour the early maturing of crops. The formation of grain begins sooner when soluble phosphate is freely available. In similar conditions, a crop supplied with a phosphatic manure will be ready a week before the one not manured. This maturing is due to a close relation that phosphorus has to seed production. Plants neither mature nor produce seeds unless the phosphorus is made available to them. Seeds therefore are very rich in phosphorus. Thus the effect of phosphorus is exactly the reverse of nitrogen in respect to maturity of crops.

This effect can be very well made use of in the case of wheat in places where the "loo" begins to blow quite early and shatters the ripening grain.

5. Phosphoric acid decreases the ratio of straw to grain in cereals. It also strengthens the straw, thus decreasing the tendency to lodge which is likely to occur especially in wheat, if too much nitrogen is present.

6 In certain cases phosphoric acid has been known to have decidedly improved the quality of the grain and crops. It reduces the nitrogen content and an increase in phosphorus follows in the grain.

It has been widely used to improve pastures in England and France. Due to its effect on roots, the root crops and other vegetables are greatly improved in quality.

7. It has a special action on leguminous crops. Soluble phosphate facilitates the change of the nodule organism from a non-motile to a motile condition, thus increasing the chance of its getting into the roots of such crops as lucerne and clover.

8. Phosphate-starvation is not so quickly recognized as that of nitrogen. The crops also differ in their sensitiveness to this element. Wheat and barley take up their supplies of phosphate in the early days of their growth; and gain nothing, in fact they may lose, from a late dressing of phosphate.

9. Phosphates increase the tillering capacity of the plants; and roots and shoots grow much better. The "ears" increase in number and mature, on the average, much earlier. It has been however noticed at Rothamsted that phosphorus without nitrogen does not give any material increase in yield.

10. As it strengthens the plants the chances of disease attacks are reduced to a great extent. This is due to the increased development of cuticle walls, which are adversely affected in the case of nitrogen.

11. Photo-synthesis may occur without it but breaking down of the carbohydrates into simpler sugars for translocation will not occur in its absence.

12. Loew was also of the opinion that phosphorus also made fats assimilable. He demonstrated that there was no cell division in the absence of phosphorus and attributed this to the absence of phospholipids, for the formation of which phosphorus is necessary. Formation of albumen also cannot proceed without it.

13. Phosphorus aids respiration because it is a coenzyme of zymase.

14. Eckerson found that when phosphorus is deficient, the enzyme, reductase, which reduces nitrates is diminished so that the plant is unable to reduce the nitrates present and

manufacture proteins. So although nitrates are present, they cannot be used, hence disintegration of proto-plasm results.

Assimilation:—This element is generally supplied to the plant as a phosphate and enters into the formation of many proteins especially those of a nucleus. It forms a very important part of the protoplasm and regulates the activities of the plants.

A very important feature of phosphatic manuring is its tendency, when added to the soil to revert into less soluble and available form. "Thus the mono-calcium phosphate of superphosphate changes at least to the tri-calcium form, or in acidic soils it forms unavailable iron and aluminium complex. The quantity of phosphatic fertilizer to be used at a time, therefore, is more or less a matter of guess rather than based on some exact figures.

Deficiency symptoms:—It is very difficult to discriminate a crop starving of phosphorus. It is not usual, before it is too late, that one can discover the deficiency of phosphorus in the soil. Again all the crops do not respond to the changes in phosphorus content of soils.

Late flowering, small seeds, small growth of plants, and occasionally dark leaves, while other conditions being normal, may be taken to be the symptoms of phosphate difficiency. Root growth is distinctly hampered due to the lack of phosphorus in most crops and specially the root-crops like carrots, beets, etc.

Phosphatic fertilizers:—1. Superphosphate:—It is a compound of calcium and phosphorus, $(CaH_4 (PO^4)^2)$ being the main constituent with some other salts of the above two elements. The phosphoric acid content of superphosphate varies from 1 to 45 per cent. It is manufactured from rock phosphate which is also used as manure.

2. Basic slag:—It is a strong alkaline substance although readily available. It makes a good fertilizer for acid soils but is undesirable for alkaline soils.

3. Raw rock phosphate:—It is not readily soluble and is therefore not utilized easily by the plants.

4. Bone meal:—The bones of the animals are mostly calcium phosphate. They take considerable time to disintegrate and change into available form specially if applied unpowdered.

5. Several other chemical combination of phosphate are in extensive use today now-a-days in western countries.

POTASSIUM

In most soils, potassium is present in sufficient quantities to provide for the necessary plant food.

It is present in such combinations in the soil that it is readily available to the plant. But this property is due to its high solubility due to which the potassic salts are easily carried away by drainage water. It may be observed that phosphorus, when applied to the soil in soluble form reverts to more complex combinations and therefore is not carried away by drainage water, but much of the potash may be taken away and may not be available to the plant.

Effects of potassium.

1. It is essential for the formation of carbohydrates and their translocation. Very little starch can be formed in its absence.

2. Proteins cannot be formed in plants if they lack potassium.

3. Cell division is seriously affected by the absence of potassium. The nucleus fails to divide and dies in course of time.

4. The weakness of the nucleus described above results in the general health of the plant. It becomes an easy prey to fungi, weather conditions, water-logging, etc.

5. Normal respiration is seriously hindered by potash deficiency, and in extreme cases results in scorching.

6. Potassium salts are radio-active and their effect therefore are of great value to the plant. It provides energy which otherwise might not be available.

7. The development of fleshy fruits largely depends upon the available potassium.

8. It is especially beneficial to leguminous crops and tuber crops because of their high carbohydrate formation.

9. It produces full, plumpy, and good seeds.

10. One of the very important effects of potassium is the balancing function of nitrogen and phosphorus. While on the one hand it makes the plants more resistant thus counteracting the effect of nitrogen, it delays maturity thus working against undue ripening influences of phosphorus.

Deficiency symptoms:—Potash deficiency is first to appear in leaves. The colour of the leaf is changed to bluish green, violet, brownish red, or brown. This is very conspicuously marked at the tip of the cereal leaves. These variously coloured spots extend towards the tips at first and spread over the whole leaf thus inhibiting photo synthesis. The tendency of potash deficient plants to premature shedding of the leaves is typical. The development of leaf is also seriously affected.

The roots are very poorly formed and assume a sickly appearance. They are weakened to the extent that root rot and other root diseases and root insects make them an easy prey.

Seed and fruit formation is considerably diminished and their mineral content is lowered a great deal. Due to its effect on cell division, the germinating capacity of the seeds is greatly impaired if it is obtained from potash deficient soils.

Due to the weak structure the health of the plant is reduced. This is due to the weak and thin cell walls of the stem and roots. The stomata are enlarged and much water is lost.

Potassic Fertilizers:—1. Potassium carbonate (K_2CO_3):—It is strongly alkaline and easily soluble. It is used in some places.

2. Potassum nitrate (KNO_3):—It is a double fertilizer but is used commonly in explosives rather than as a fertilizer.

3. Muriate of potash (KCl):—Most commonly used as a fertilizer. It is mined in France and Germany.

4. Kainite:—It is an ore containing several elements like potassium, magnesium, sodium, etc. It is obtained from Germany.

5. Molasses:—It contains potassium in appreciable quantities.—It also helps in reclaiming soil alkalinity.

BENEFICIAL INSECTS IN AGRICULTURE

By

E. J. W. Moraes, B.Sc. (Agr.)

Insects form a very important class in the animal kingdom, in that the class Insecta comprises of the largest group of individuals to be found in any one class. But we as agriculturists need to study them for another great reason—that this group also includes many of the farmer's best friends. Yet, we find, that almost every book or article written on insects deal with their destructiveness, and that also to such a degree, that we very often forget that there actually exist useful insects. We should make a deep study of these little creatures, so as to be able to distinguish between those that are harmful, which should be destroyed, and those that are useful, which we ought to help multiply. We shall first deal with a few commercial insects which, in some ways, have some connection with agriculture.

Mulberries, castor, etc., are grown in many parts of our country for the sake of their fruit or oil. But it is on such plants also, that our very useful friends, the silk moth catterpillars, are reared. Honey bees also should have a place among our list of friends in the Insect world. They act as pollenizers, as we shall learn later, and also as honey collectors or storers. Our friend Coccus cacti (or Cochineal insect) also has our affection in that it is useful both commercially and agriculturally. We shall now speak of each of these three friends in more detail.

The Silk Moth

There are many species of this moth to be found in India. The French silk moth, the Japanese silk moth, (Antheraea yamamai); the Eri silk moth (Philosamia ricini); Antheraea assama (found in Assam). Most people who use silk never think of its origin, and a large number still do not know that silk is caterpillar's spittle.

The moth is creamy white and about two inches across the open wings. It never eats, and only lives for two or three days. Within this short period of life, however, this moth is able to mature and lay from 300 to 400 eggs. These eggs give rise to caterpillars which feed on mulberry or castor leaves, pupating at the end of 3 to 4 weeks after first having spun their silken cocoons. The pupa in turn produces the moth, and this change takes 2 to 3 weeks. It is the long, continuous, silken thread of each cocoon that goes to make our silk clothes.

Honey-bees.

We are inclined to think of the honey bee as being the producer of that delicious substance called "honey." It does not, however, make the raw product, but is only an intermediary between honey bearing plants and man. They gather these sugar-bearing secretions of plants and store them in minute waxen tubes of their own making. The bees are merely harvesters, as they swallow the nectar; and due to the mixture with the saliva, it undergoes some chemical changes. Probably the bees also add some of their own ingredients. After the nectar is thus mixed in the mouth of the bee, it is brought out, or spat out, in the honey comb cells. Here the nectar is concentrated by the evaporation of a large part of its water content in a strong current of air, produced over the cells by the rapid beating of the wings of the worker bees. When a cell is filled with properly "ripened" honey, it is sealed with wax. Besides honey, we also get bees wax, which is used extensively in many arts and trades. The honey-bee domesticated here in India is Apis indica. Other Indian species are A. dorsata and A. florea.

Coccus cacti.

Cochineal is the dried, pulverized bodies of a kind of scale insect, Coccus cacti, that lives on the prickly pear (Opuntia coccinellifera). Cochineal is now used principally as a cosmetic for decorating cakes, colouring beverages and

medicines. About 70,000 insects are required to make 1 pound of cochineal.

We shall now deal with those that are beneficial only in agriculture. All these may be divided into different groups as follows :—

(*a*) Insects that aid in the production of fruits, seeds vegetables and flowers., by pollinating the blossoms.

(*b*) Those that destroy other injurious insects.

(*c*) Those that destroy various weeds.

(*d*) Those that improve the physical condition of the soil and promote its fertility.

And (*e*) Those that act as scavengers.

Insects as Pollenizers.

Plant life is maintained from generation to generation in two ways: (i) by asexual reproduction, and (ii) by sexual reproduction.

In sexual reproduction one specialized reproductive cell, the male gamete, unites with another, the female gamete, and from this union a new individual arises. In higher plants, sexual reproduction is made possible by a process known as pollination. The pollen may be carried from the anthers of one flower to the stigma of another in two ways—either by wind or by insects. Wind-pollinated flowers are usually small and inconspicuous, with poorly developed petals. They are chiefly unisexual and have dry, light pollen, and brushlike stigmas. Examples are corn, wheat and other cereals, oaks, pines, etc. On the other hand, insect-pollinated flowers are mostly large, with well-developed corollas of showy colours or with a marked odour. The pollen grains are sticky and so also are the stigmas. They are dependent mainly on the visit of insects to carry pollen to the stigmas and thus make fertilization possible, without which no seed or fruit will form. These flowers also have nectaries, that secrete a sweet

liquid which insects use as food; and for this alone do the insects visit these flowers. These are all various means of attracting insects. The flowers are also so constructed that when insects visit them to collect nectar they are compelled to carry away with them a load of pollen, and as they crowd their way into other flowers some of the pollen on their bodies is brushed off on to the stigmas of these flowers. Such plants are clover, cotton, many vegetables and fruits. Some of these insects are:—

Honey-bees.

The pollen which sticks to the body hairs of these bees is removed, by the bees, by means of a highly specialized brush situated on the basal segments of the tarsus of the hind leg. When this brush is filled with pollen, the hind legs are crossed and the pollen grains on these brushes are scraped into the pollen basket. This basket is formed by the large marginal bristles of the tibia. The pollen is then carried to the hive in this pollen basket. At the hive, the pollen is removed by means of a spine on the end of the middle leg and stored as food for the bees, some of it brushes off on to the stigma when the bee or other insect visits the next flower in search of nectar.

Bumble-bees.

These replace the honey-bee, in the case of flowers with deep set nectaries such as the red-clover in America. The honey-bee does not visit this flower because it finds that it is not possible to collect nectar from it. In Australia it was found impossible to obtain seed from red-clover until the bumble-bee was imported into that country. They belong to the family Bambidae.

Miscellaneous.

Some wild, solitary bees belonging to the species tetralonia and melissoides have also been found to be efficient pollenizers of red-clover. Many flies, butterflies, moths and beetles help a great deal in cross-pollination, but unfortunately many of them produce injurious caterpillars, grubs or

maggots which offset the benefit derived from the parents. Bees and wasps develop no objectionable progeny.

Fig insects

It was revealed, by careful studies, that the palatability of the Smyrna fig is dependent upon the pollination of the flowers. The fig is a hollow, pear-shaped receptacle that bears a very large number of minute flowers lining its inner surface. The only entrance to the flowers is a tiny opening at the face end of the fig If the flowers are not fertilized, the seeds do not form, and the fleshy, nearly closed receptacle that bears the seeds does not develop the sweet flavour that characterises the perfect fruit. Besides this, the Smyrna fig is unisexual (only the female part). Hence the pollen must be carried from the wild fig or caprifig, which produces plenty of pollen but whose fruits are inedible. The only means of pollinating the edible fig is by the aid of a small wasp called Blastophaga psenes. This wasp lays its eggs only in the wild fig, though it enters other figs also while searching for a place in which to lay. The larvae develop at the base of the flower of the caprifig. The male adults are wingless and hence never leave their home. They fertilize the females while they are developing. After mating, the female squeezes herself out of the small opening in the fig and while so doing gets covered with pollen. They then fly about in search of a place wherein to lay their eggs. While so doing, they enter both the Smyrna and caprifigs. Thus they scatter pollen in the former figs also. From this we could also note that both types of figs must be grown so as to keep up the supply of these wasps. Instead of growing these two kinds of figs in the same orchard,—they are better grown separately—at the time of fertilization figs containing mature wasps are removed from the wild fig trees and suspended among branches of the edible fig tree.

Insects That Destroy Other Injurious Insects

The greatest single factor that checks the plant-feeding insect from overwhelming the whole world is that they are

fed upon by other insects. These useful insects control the harmful ones to a greater extent than man could. They are divided into two groups:—(i) Predators and (ii) Parasites. The former are those that catch and devour smaller or more harmless ones, called the prey, usually killing them in getting a single meal. The prey does not determine the habitat of the predator. Parasites on the other hand make their homes on or in the bodies of other insects, called the hosts, and from which they get their food. The hosts are usually larger and stronger and are not killed promptly. The host also determines the habitat for the parasite.

Predators.

Aphidlion or lace winged fly:—It is of very little importance in the adult stage, but the larvæ are of great help to the farmer, as they grasp and puncture the bodies of aphids or their eggs, or other small insects. The eggs are laid on the leaves or stems of trees, vegetables or field crops. The larvæ are spindle-shaped and have very long, sharp-pointed mandibles, with which they attack their prey. They also have extra wide thoracic segments. They spin small, white silken cocoons in which they pass the winter days. In the Spring, the adult hatches out and escapes by cutting off a circular lid, thus making an opening in the cocoons

Ground beetles:—Many of them are injurious, by feeding on seeds and berries, but there are also some beneficial ones (*e g.* Calosoma sycophanta—a European species). Calosoma sycophanta preys on the gypsy and brown-tail moths. Both the adult and the larvæ feed on the adults and larvæ of some of the harmful insects. The adults are black or brown in colour, strongly built, flattened, long-legged and swift in moving. They are chiefly nocturnal. The larvæ are slender and somewhat flattened, tapering towards the tail.

Lady beetles:—The more common species are red, brown or tan, usually with black spots or markings. Some are black spotted with red. They have bright bodies, are nearly hemispherical in shape. They are from 1/16″ to $\frac{1}{4}$″ in length and about 2/3rds. as broad. These beetles resemble

some of the destructive ones, so it is worth knowing that the lady beetle has a three-segmented tarsi, while the harmful leaf-beetle has four segments in each tarsus. The adults and larvæ feed on scale insects, aphids and other small, soft-bodies insects or their eggs. The larvæ have flattened bodies, gradually tapering. They have long legs, spiny backs and distinct body regions. The pupa is not enclosed in a cocoon, but has the tip of its abdomen cemented to the leaf. The eggs are orange and may be in masses of a dozen or more. The leaf beetles belong to the family chrysomelids, whereas the lady beetles belong to the family coccinellidae. There are many species of lady beetle, the most common being Coccinella septumpunctata (7 spots).

Syrphid flies.—Only the larvæ attack other insects. Almost every aphid colony is attacked by these larvæ. They are elongate, footless, and slug-like and are tan or greenish in colour. They grasp the aphids by their pointed jaws and pick out and suck out all the body contents, leaving only the skin. The adults lay their eggs singly among groups of aphids. The eggs are white and elongate. The flies feed on nectar and pollen and thus aid in pollination. The adults are usually banded or spotted with bright yellow or covered with long black and yellow hairs and should not be confused with wasps and bees. They also have only one pair of wings, and the false vein in the wing is characteristic of the flies of this family—Syrphidae.

Parasites.

Tachinid flies—(Winthemia guadrpustulata). They are grey, brown or black mottled flies. They differ from the house fly (Musca domestica) in that they have an entirely bare bristle on the antenna. The adults feed on foliage or flowers. They lay their eggs on the body of the caterpillars of moths and butterflies or on leaves where their hosts may ingest them. The flies lay their eggs usually on the thorax since the host could easily bite off the eggs if they are situated at the rear end of the body. On hatching, the larvæ burrow through the skin of the host. They feed on the caterpillars, which may not die at once but may even pupate

before they die. Then the parasitic fly emerges from the cocoon instead of the moth or butterfly. Army worms are one of their principal natural enemies.

Chalcid wasps:—Most of them are parasitic, though a few species, such as the fig wasp, feed on plants. Many species live within the bodies or eggs of scale insects, aphids, caterpillars and flies. Phromalus puparum is very beneficial as it attacks our common cabbage worm. They are about 1/15" long, and have a metallic lustre. The wings generally show a single vein. There are some species which feed on the beneficial insects, and hence are to be considered as the farmer's enemies.

Braconid wasps:—A species beloning to the genus Microgaster lays its eggs in the body of the tomato hornworm. The larvæ feed on the tissues of this caterpillar and when full-grown eat through the body wall and come out. They fasten their cocoons on the body of the host. These cocoons are elongate and white. Some others belonging to the genus Aphidius feed on aphids.

Insects That Destroy Weeds

Many insects help the farmer by feeding on weeds; but unfortunately many of them wander off from the weeds on to crcp plants usually of the same family as the weed attacked.

The milk weed is attacked by Tetraopes tetraophthelmus (red milkweed beetle); Chrysochus curatus (blue milkweed beetle); and Danais archippus (milkweed butterfly). The pig-weed is attacked by Piesma cinerea (a small lace bug).

Purslane weed is attacked by Celario lineata (a species of hornworm). Cactus growth is greatly checked by a scale insect Coccus cacti. One of those that may also attack crop plants are the bean aphid (Aphis rumicus). It attacks pig-weed but also migrates to beans.

Insects As Soil Builders

To be productive of plant growth, the soil must contain at least the following substances: minute mineral particles

derived from disintegrating rocks, organic substances derived from dead plants and animals, water and air.

Insects help a great deal in breaking up rock particles and bringing them to the surface thus exposing them to the various weathering influences. They help in interchanging the soil, in æration, drainage, and the addition of organic matter. By burrowing, they bring soil from lower layers to higher and also to the surface thus covering plant and animal matter lying on the surface. They help the circulation of air into the soil by making tunnels They burrow to depths varying up to 10 feet and sometimes even more. The burrows also help in the movement of capillary water. They add humus to the soil in many ways. The bodies of dead insects accumulating at the surface of the soil are a fertilizing element. Their excreta also add to the humus in the soil. Termites, ants, dung beetles, etc., carry organic matter into the soil for their food. However, nothing on earth is perfect; and so we find that many of these, such as termites, do harm as well as good.

Insects As Scavengers

They feed on decaying plants and animals, converting them into simpler substances which can be easily utilized as food for growing plants. The larvæ of many flies and also the adults and larvæ of many beetles help a lot in this way.

Conclusion

From this brief look into the usefulness of insects, we find that we owe a great part of our existence to these beneficial insects. Even if man in general allows the destructive insects to wipe out from his thought the existence of useful ones, let us as farmers, praise their work and do our best to spread the knowledge of these friends and co-workers of the agriculturist.

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REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES

FOR APRIL, 1941

I—Season.—During the month of April, the whole of the Province was practically rainless.

II—Agricultural Operations.—Agricultural operations are generally up-to-date. Sugarcane and extra crops are being irrigated. Threshing and winnowing of *rabi* crops are in progress.

III—Standing Crops, and IV—Prospects of the Harvest.—The condition of the standing crops in quite satisfactory.

V—Damage to Crops.—No damage is reported from any district except a few cases of fire from certain villages in the Bulandshahr, Jalaun and Naini Tal Districts.

VI—Agricultural Stocks.—The condition of the agricultural stock is fairly satisfactory. Cattle disease has been reported from certain districts. Rinderpest and foot-and-mouth and haemorrhagic septicaemia diseases have increased to a great extent as is indicated by the following figures furnished by the Director of Veterinary Services, United Provinces.

Disease	March, 1941		April, 1941	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	510	339	1,826	837
Foot and mouth	4,944	41	16,640	113
Hæmorrhagic Septicæmia	58	49	81	72

VII—Pasture and Fodder.—Fodder and water are reported to be sufficient everywhere.

VIII—Trade and Prices.—The prices of chief food grains such as wheat, barley and gram have fallen slightly except rice and arhar dal which show slight increase. The following figures compare the retail prices, in rupees, per maund, at the end of the month with those of the previous month:

	End of March, 1941	End of April, 1941
Wheat	3·494	3·310
Barley	2·226	2·167
Gram	2·735	2·613
Rice	5·094	5·391
Arhar dal	3·651	3·706

IX—Health and Labour in Rural Areas.—The condition of agricultural and labouring population is generally satisfactory. Cases of small-pox and cholera are reported from certain districts.

FOR MAY, 1941

I—Season.—The first and the fourth weeks of the month were practically rainless. Rainfall during the second and third weeks was general and fairly distributed. It was above the normal in 26 districts, the district of Dehra Dun topping the list recording above 3 inches.

II—Agricultural Operations.—Agricultural operations are generally up to date. Irrigation of sugarcane and extra crops and preparation of land for *kharif* crops are in progress. Sowing in canal irrigated area has commenced.

III—Standing Crops and IV—Prospects of the Harvest.—The condition of standing crops is fairly good and the prospects are so far favourable.

V—Damage to Crops.—Some damage by hailstorm and fire is reported in some districts.

VI—Agricultural Stock.—Cattle disease is reported almost from every district Hæmorrhagic Septicæmia and Rinderpest have increased to a great extent while Foot and Mouth disease has decreased to some extent as will be seen from the following figures furnished by the Director of Veterinary Services, United Provinces:

Diseases	April, 194˙		May, 1941	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	1,826	837	2,735	1,302
Foot and mouth	16,640	113	12,238	62
Hæmorrhagic Septicæmia	81	72	145	111

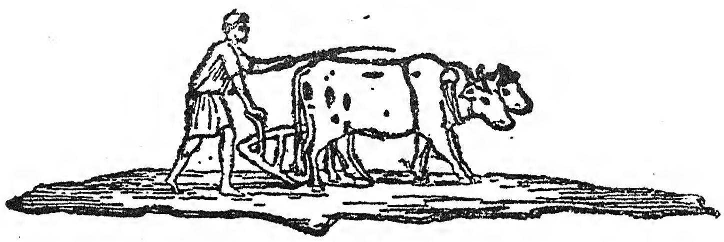
VII—Pasturage and Fodder.—Fodder and water are reported to be sufficient everywhere.

VIII—Trade and Prices.—Prices of the chief food grains, such as wheat, barley, gram and rice have risen slightly except that of arhar dal which remains nearly stationary. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

	End of April, 1941	End of May, 1941
Wheat	3·310	3·592
Barley	2·167	2·217
Gram	2·613	2·725
Rice	5·391	5·494
Arhar dal	3·706	3·669

IX—Health and Labour in Rural Areas.—The condition of agricultural and labouring population is generally satisfactory. Cases of cholera and small-pox are reported from certain districts.

THE ALLAHABAD FARMER



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Editorials

Irrigation and Its Problems.

Every one who is connected with agriculture knows that water is one of the most important factors in crop production. Over a great portion of this country, this is a factor which greatly limits the production of crops. The failure or even the delay or irregularity in the monsoon very often results in famine and the consequent suffering of a very large number of the population in this country.

In order to safeguard himself against the failure of crops due to the failure of rain and also in order to supplement the very inadequate supply of water for most crops, the farmer in this country has very often to resort to the digging of wells all over the area, where ground water is available at reasonable depths. Well irrigation is consequently one of the most common methods of irrigation in this country. But this is also one of the most expensive methods of irrigation, although this expensiveness is very often a blessing in disguise as the farmer has learnt the lesson of how to use water

economically. The farmer not only uses less well water than canal water, but as a rule the produce of well-irrigated lands is about 30 per cent more than of canal irrigated lands.

Governments in this country have from very early times felt the need of giving the farmer more water for his crops. Consequently, Governments have almost continuously built up a system of canals all over the country so that the country has over 30,000,000 acres under canal irrigation. Of this, however, the Punjab alone has over 11,000,000 acres. The United Provinces has at present at least 3,750,000 acres, under canal irrigation, and the area is increasing every year. However, even this area is only a small portion of the area that ought to come under irrigation.

With the provision of facilities for irrigation, however, it seems there has been an increase in some areas of alkali or usar lands. Thus very often soils which have come under irrigation have in the course of a few years become unproductive. For some years it was thought that this appearance of alkali was due to the rise of the ground water or the rise of the 'water table' as it is technically called Recent investigations in the Punjab however seem to show that the appearance of alkali in that area is mainly due to the injudicious use of water or to the improper management of the irrigation water which results in the formation of a zone of accumulation of the existing salts in the soil crust. The depth of the position of this zone of accumulation again depends on the intensity of irrigation. In fact the investigations referred to seem to indicate that by the proper use of irrigation water and a proper sequence of cropping these alkali lands may be reclaimed. The procedure recommended is the leaching of the salts followed by the growing of a rice crop. This is to be followed by a green manuring crop such as *berseem (Trifolium alexandrinum)* or *senji (Melilotus parviflora)*.

It is hoped therefore that whenever facilities for irrigation are made available to cultivators by Governments, adequate instruction be also given to them for the proper use of irrigation water, so that those soils which come under irrigation may not deteriorate.

Agricultural Education.

That agricultural education is spreading in this country is evidenced by the fact that in the United Provinces alone we have now four degree colleges teaching Agriculture: the Government Agricultural College in Cawnpore, the K. E. M. Jat Agricultural College at Lakhaoti in the Bulandshahr district, the Balwant Rajput College in Agra, and the Allahabad Agricultural Institute in Allahabad. The first three are affiliated to the Agra University, whereas the last, that is the Allahabad Agricultural Institute, is the Agricultural section of the Allahabad University. This province has also at present two other agricultural colleges of Intermediate grade one at Baraut in the Meerut district and another in Muttra. Besides these colleges, the Government of the province has two agricultural schools, one in Bulandshahr and another in Gorakhpur.

In the number of agricultural colleges therefore this province is far ahead of the other provinces. For, as far as we know, Bombay has one agricultural college in Poona, Madras has one in Coimbatore, the Central Provinces has one in Nagpur and the Punjab has two, one in Lyallpur and another in Amritsar. These colleges were established by Government about 35 years ago, except the last which is a non-Government institution.

In the other provinces, Bengal has only recently started an agricultural college which teaches up to the B.Sc. standard. On the other hand Bihar several years ago closed down the only agricultural college it had in the province, namely the agricultural college at Sabour. Assam has as yet no agricultural college. We learn, however, that the newer provinces like Sind and Orissa have either started agricultural colleges or are contemplating starting them.

As the need for agricultural education in the other provinces is we believe as great as in this province, we do not quite understand why the other provinces have been so slow in starting their own agricultural colleges The existing agricultural colleges in this province find it extremely difficult to admit all the students who apply for admission from this province. The Government Agricultural College at

Cawnpore reports 480 for eighty two seats in the first year class of 1939. And the number of candidates applying seems to be increasing every year. The Allahabad Agricultural Institute also receives something like 200 applications every year for 35 seats in the first year class. And about 35 of those applying every year were from Assam.

We are therefore convinced not only of the great need, but of the very great demand for agricultural education, all over the country. We therefore hope to see in the near future the instituting of agricultural colleges not only in the British provinces of India, but also in many progressive States of this great Indian Empire

The Punjab has in some respects gone ahead of this province, the United Provinces, in that it has for some years now offered an M.Sc. course in agriculture in the Agricultural College in Lyallpur; whereas in this province none of the above-mentioned degree colleges has any provisions for post graduate teaching of the M. Sc. standard. To be sure several of the graduates of agriculture of this province have opportunities for further study in Agricultural Botany in the Benares Hindu University, and a few go up for post graduate training in the Imperial Agricultural Research Institute in New Delhi. But the number of men who are admitted to those institutions is very small, on account of the very limited number of seats available. Some of the universities in the province do also take agricultural graduates for the M. Sc. degree in such allied subjects as Botany, Zoology and Chemistry, or for the M. A. degree in Economics. Some agricultural graduates have even gone in for law. However we feel that the conditions are now ripe for the institution of an M. Sc. degree in at least one of the existing agricultural colleges of the province. We would therefore draw the attention of those who can provide the facilities for higher training in agriculture to consider this important question, so that we may have in our own province an opening for those who are qualified to go forward.

Also by raising the standard of agricultural education in this country we shall be helping the development of the agricultural industry in general.

A CHRISTIAN RURAL FELLOWSHIP IN INDIA

The economic and social problems of the villager are of concern to all who are trying to help India. Many Christian workers are attempting to help him to solve them, in many different ways. Some of these men and women are engaged primarily in evangelistic or educational or medical work; only a few are devoting the major part of their attention to these problems. Some are tackling the task consistently, year after year, some sporadically, and many more realize that they should be doing something to improve the material condition of the people among whom they work, but having many other duties, and but little idea of definite steps which might be of value, find it easy to postpone this part of the work.

The belief that much more could be accomplished if those who were interested knew what others were doing, and were acquainted with projects which are proving successful, led Mr. Moomaw, Principal of the very effective Vocational Training School at Anklesvar to call a meeting in Landour this summer. Enthusiasm for the idea was shown, and a small committee was appointed to plan for an organization to provide for an interchange of experience and plans, and the encouragement of service of this sort. Many are acquainted with the Christian Rural Fellowship in the United States, largely through the literature which it circulates. The Fellowship also holds meetings in different parts of the country at which its members discuss the problems of rural life. Some of the more significant addresses are printed and thus made available to the much wider group all over the world. It therefore seemed to some that an organization on similar lines might serve the need in India, and that possibly the group here could become a branch of the Fellowship in America.

The committee felt that the time was ripe for an organization of some sort, and that it was desirable to start at once, rather than waiting until definite plans could be approved by any large group. As the main function is the exchange of information and ideas, there seems to be no need for an elaborate organization. The committee decided

that for the first year, at least, the only officer needed would be a secretary. It was decided to request the Allahabad Farmer, the bi-monthly magazine of the Allahabad Agricultural Institute, to provide space for a Rural Life Fellowship department. This the Farmer has agreed to do. It is planned to have a meeting of the Fellowship in Landour in the summer of 1942, at which time it can be decided what the permanent set-up shall be. This meeting, however, should be largely a conference on methods of rural work.

Members are being enrolled, and the initial response indicates that the Fellowship will meet a real need. While it is expected that there will probably be an annual conference in Landour, and that members will be mainly from the rather large group of those who go to Landour at least occasionally for the summer vacation, there is no geographical limitation, and others interested will also be welcomed. Not knowing how many would become members, or just what expenses might be involved, the committee fixed the membership fee for this year at Rs. 2, which should cover postage, printing, and the expense involved in the conference to be held next summer. Subscription to the Allahabad Farmer is Rs 3 a year. Reprints of Fellowship material appearing in it can be sent to members who do not receive the magazine, or it may be possible to work out a joint membership fee and subscription. Many of the other articles in the Farmer are of general interest to those engaged in rural work of any sort.

Two things are now necessary to make this venture a success One is that those interested manifest their interest by sending Rs. 2 (or Rs. 5 if they wish to subscribe to the Farmer also), to provide the necessary cash for the first year. More important than this is to send in brief accounts of rural projects of all sorts. This should not be delayed until the project is a complete success, or all the details have been worked out. Much is being accomplished, largely in little bits scattered over the country. It is of these beginnings and small accomplishments that all should know. Contributions of both sorts may be sent to the undersigned at the Agricultural Institute, Allahabad.

W. B. HAYES, *Secretary.*

SUGAR CANE BREEDING IN INDIA

By

M. A. Hogue, B. Sc. (Ag.)

Introduction.

Cane cultivation in India dates back to the remote past. Barber believes that Indian cane originated in the north-eastern parts of India. Even today the acreage of cane in India is greater than in any other single country in the world. India has very many natural advantages for the growth of sugar cane and for the sugar industry in general. Despite these, India has found it difficult to compete with Java and other sugar cane producing countries. The importance of cane in India was well brought out by Mr B. C. Burt, the Agricultural expert of India. "During present times of agricultural depression" he said, "the sugar cane crop has been the one redeeming feature in thousands of villages of Northern India. It is at all times a crop which gives the Indian cultivator a relatively larger reward for his labour and gives him employment throughout the year." Though India is believed to be the home of cane yet even a few years back she was not able to depend on her own sugar. Even during the year 1929-30 she had to import about one million tons of sugar. A perusal of the statistical figures will reveal the deplorable condition of sugar cane in India.

Countries.	Sugar obtained per acre.	Percentage of sugar obtained from cane.
India	43·6 mds.	9·4.
Java	717·5 mds.	12·35.
Peru	1015·8 mds.	
Hawaii	1512·9 mds.	

Even a few years back the average percentage of sugar in cane was as low as 6 to 7. In spite of the fact that India is the original home of sugar cane, its culture here lagged a long way behind the rest of the world. In fact cane growing was at such a low ebb that in parts of the Punjab the cane grower was content if in a bad season he got enough food for his cattle and some *gur* for domestic use. Until 1911 cane cultivation in India was solely in the hands of cultivators who paid little or no attention to the improvement of the crop. Though India was growing the largest acreage of cane she was depending on foreign sugar on account of her low yield. It was only in the year 1911 that the Government of India paid its attention to the improvement of the crop. In those days indigenous canes were of very low sugar content, and their yield also was very low. Almost all the cane grown in Northern India was very thin. What was required was to find some strains of cane adapted to the short season in N. India with a high sucrose content and high yield.

Methods of Improving sugarcane.

I *Selection* :—Prior to the establishment of the first sugar cane breeding stations in Java and Barbados the improvement of cane was effected by means of selection of materials from different localities. In the tropics selection was confined to the varieties of Saccharum officinarum (Noble canes). In the sub-tropical areas of India and Indo-China comercial varieties were selected from Saccharum Barberi and from S. Sinensis. Selection plays a great part in keeping the varieties pure. Very often bud mutation is found to occur in cane. The mutant buds should be disposed of after careful observation.

Selection in the improvement of cane is now-a-days out of date. Improvement in this case is limited, unless there is any mutation of desirable type.

II *Hybridisation*:—Hybridisation in cane, a wonderful discovery of plant breeders, is not very old. Even up to 1886

seed of sugar cane had not been figured or described by botanists. Existence of functioning or viable seed was doubted by responsible observers. Reports of the occurrence of natural seedlings in Java and elsewhere had been made for many years but with no evidence of actual handling the seed or planting it, and claims respecting this chance of natural seedlings were usually met with ridicule. In the year 1887 occurrence of true seed and its observation was noted in Java. Similar reports also came from Barbados in 1888.

Hybridisation has produced wonders both in India and outside. At present hybridisation accompanied by selection is the best method of improving cane. Variability in canes, vegetative reproduction and existence of related crop and wild plants have made the process of improvement extremely easier. Once a variety is obtained it can be perpetuated true to its type by cuttings. It is not necessary to purify the type so that it will come true.

During 1885 to 1925 Java got an increase of 300% in the yield of sugar by taking up cane breeding. In India breeding work was started only in the year 1912 by Barber at Coimbatore. Breeding of cane has led to an increase in the tonnage, surgar content, disease resistance and various other agronomic and economic characters. It also enables the combination of different characters in one variety.

The only difficulties in the way of cane breeding are that some varieties have never been known to flower, some may not flower at all in a particular season, others may flower only once in 5—6 years. Certain crosses may not be possible because the two varieties flower at different times or because both are of the same sex. The mode of inheritance in this crop is not yet known and chance plays a great part in the breeding and selection of improved strains.

Classification

Sugarcane belongs to the genus Saccharum of the Graminae family. This genus includes many troublesome weeds. In 1912 Barber classified Indian canes into 5 groups *viz.*, Saretha, Sunnabile, Panshahi, Nagori and Mungo. Accord-

ing to him Saretha included all those canes which had their anthers open and the canes were thin and long. Sunnabile canes were thick, short with anthers closed.

The genus as represented in various countries has been classified into 7 species by Jeswiet and others.

1. S. officinarum—Noble cane.
2. S. Sinense : 3 groups—Panshahi, Nagori, Uba (Mungo)
3. S. Barberi : 2 groups—Saretha, Sunnabile.
4. S. spontaneum—*Kans.*
5. S. robustum } Weeds.
6. S. biflorum } Weeds.
7. S. narenga } Weeds.

The following is a key for identifying the above groups :

A main axis of the inflorescence carrying long hair.

B.	Lodicules ciliate	... S. spontaneum.
BB.	Lodicules non ciliate	
C	Leaves broad	... S. Sinense.
Cc.	Leaves narrow	... S. Barberi.
AA.	Main axis of the inflorescence without hairs	... S. officinarum.

Sunnabile has:— Dahulu in Punjab.
Mohora in Assam.
Dhor in C. P.
Sunnabile in Bombay.
Nanaal in Madras.

Panshahi has:— Kahu in Punjab.
Chinia in Mysore.
Ketari.

Nagori has :— Nagori, Mungo, Sewari.

Saretha has :— Katha in Punjab, and Chin and
Saretha in Western U. P.
Khari in Bengal.
Hulukabbu in Western Coast.
Ganda Cheni in Mysore.

Flowering in Cane.

The inflorescence of sugar cane called an "arrow" is a panicle one foot or more in length with numerous branches borne at the end of the stem. Arrangement of spikelets is racemose. The spikelets occur in pairs one of which is pedicillate and the other sessile. While flowers of all varieties are perfect with both male and female organs, many of the varieties do not produce fertile pollen. Very few varieties are completely sterile. Varieties that produce fertile pollen are self fertile and may be used to produce selfed seed; or they may be used to pollinate varieties that have sterile pollen thus giving cross-bred seeds. In general varieties that produce an abundance of fertile pollen are called males and those that produce little or no fertile pollen are called female. The fertility or sterility of pollen is not always a constant characteristic of a variety. Varieties which have fertile pollen in one locality may have sterile pollen in another and some varieties change from year to year depending on weather conditions preceding and during flowering. Arrowing in cane seems to depend on climatic conditions and most of the varieties which flower profusely in Madras, Assam and parts of Bengal do not flower in north-western parts of India. At Coimbatore they tried to induce flowering by sowing cane in different months, and they found that November is the best month for sowing in order to induce flowering. In some localities in India, arrowing is supposed to be very ominous. For some time arrowing was believed to deteriorate the cane. Batham and Nigam (U. P.) showed to the contrary that arrowing tends to increase the sucrose content and decreases the glucose content. Krishnamurti and Rao working at Coimbatore showed that arrowed canes deteriorate after about 2½ months from the time of arrowing.

Technique in the Breeding of Cane.

Technique in the breeding of cane varies widely in different countries. In Java the male tassel is cut and its bottom is dipped in water. In this position it is tied to the female plant where pollination takes place.

At Coimbatore the method followed is quite different. For selfing, the arrow is covered with a muslin bag hung from a horizontal bar tied to a bamboo-pole. For cross-breeding, a large number of stalks of varieties in the early flowering stage are transplanted away from other plants. Two parents are generally put side by side. During arrowing the two arrows are covered in a muslin bag suspended from a bamboo-pole. This method is sometimes modified and parent plants are grown in alternate rows. During arrowing one male and one female plants are tied together and then covered by a muslin bag. When the time of flowering in two varieties differs by a week or so, the pollen can be preserved and then used.

Emasculation is no longer done in Coimbatore as the process is laborious and seeds obtained is limited.

Brief summary of the work done in India

In a meeting of the Board of Agriculture at Pusa in 1911 it was decided to open a cane breeding station at Coimbatore. The station was opened during 1912. The chief aim was to raise hardy cane-seedlings having high yield and high sucrose content. Barber took charge of the new station. The problem before him was to develop strains of canes which will be suited to climatic conditions of northern India. Barber was the first man to classify Indian canes. He first recognised the close affinity of Saccharum spontaneum with the canes of northern India and tried to introduce the hardiness of that wild species into the parentage of cross-bred canes, a work that he carried out at that station. During 1916 Barber attempted to trace correlation between sucrose content and tillering capacity on the one hand and certain morphological characters as leaf measurements on the other hand. Though he obtained indications of correlation: no correlation co-efficients were worked out. His objective was the discovery of some characters which could be identified in the seedling and used as a means of early elimination of undesirable material. His success in the breeding of improved varieties is very widely known, both in India and outside. The crosses with S. spontaneum were outstanding in their root development, resistance to water-logging and hardiness.

Barber was well followed by Venkatraman. He commenced the difficult study of a preliminary identification of the elementary characters of the plant. Of the more important of such characters which he dealt with were leaf width, leaf sheath colour, ligular processes, hairs on the nodes, shape of joints, length of internodes and ivory markings. Of the greater interest are his observations on vigour, habit, tillering capacity, thickness of the cane, quality and quantity of juice, root character and susceptibility to smut. The cross Co. 205 proved suitable for the unirrigated parts of the Punjab. Later he got Co. 285 (striped Mauritius Co. 205). The sugar cane planting season in the Punjab is in the middle of March. After planting, canes pass through comparatively unfavourable conditions for growth till the advent of the south-west monsoon. About 12—14 weeks from the time of planting might be considered rather a critical period for the young cane plants. Co. 205 and Co. 285 were better adapted for those regions on account of the slower and more gradual development of sett-roots enabling the plants to tide over unfavourable conditions. These canes develope a well established root system and are ready to start development with the monsoon.

This was followed by the problem of breeding thick canes in India. Thick canes (S. officinarum) are grown chiefly in Madras, Bombay, parts of Bengal and Assam and also in U.P. and Behar for chewing.

The main problem in this case was to breed a cane which will be thick and hardy with heavy yield. Thick canes flower earlier than other canes. This brought the new difficulty of securing pollen required for the work. About 70 varieties which were of use in hybridisation were studied so far as their pollen fertility is concerned. In order to obtain necessary strains various crosses were made. In 1931, the first batch of seedlings was sent to different stations in Madras for studying their behaviours. New seedlings were also sent in 1932 to other stations for study. Mention may be made of Co. 360, Co. 402, Co. 408 and Co. 419 which came out prominent.

Co. 360 is a cross of P. O. J. 2,725 and Q. 116. It has heavy yield, good root system and high sucrose content,

Co. 402, (a cross of vellai and Co. 243), Co. 408 (a cross of P. O. J 2725 and Co. 243) and Co. (429 a cross of P. O. J. 2,878 and Co. 290) are hardy and heavy yielders.

The attention of the authorities was then diverted to the breeding of some strains of early cane. Sugar cane is a long duration crop and in northern India the growth period is limited by high temperatures during May and June and by low temperatures during the winter months. Early varieties are also required to facilitate the extension of the crushing season. The difficulty arose about the selection of parents. *Juar*, *motha* and *bajra* were taken into consideration. *Bajra* and *motha* were soon discarded. The *juar* selected was a grain type, known in south India as Periamanjal (Sorghum durra). It matures in about 6 months. The other parent used was P. O. J. 2725. This was used as female for its good qualities and its capability of producing large quantity of viable seeds. Crosses were made and seedlings were tried. Co. 351 to Co. 357 are all juar-sugar cane hybrids All these have quite high (15-18%) sucrose content. The first trial was made in the year 1932-33. As for the expected early maturity, the result was not very satisfactory. Only Co. 351 and Co. 357 had a tendency to mature in about 8 months.. Others took as long as 11 months. In Anakapalle it was also found that seasonal variation had a marked effect on maturity. The early March planted crop matured in 10 months while the June planted crop matured in 8—9 months, but the quality of the crop was poorer. Sorghum hybrids were also found to mature with the advent of cooler months with lower humidity. The juice of sorghum hybrids at the point of their maximum efficiency were decidedly richer than those of other Coimbatore canes. These hybrids show a tendency of withstanding drought. Sugar cane Sorghum crossing was the first successful one in the inter generic breeding of cane in the world.

Encouraged by the success in the inter-generic hybridisation Venkatraman crossed bamboo (Bambusa arundinacea) during 1936 with P. O. J. 213 and P. O. J. 2725 which flower during the time of flowering in bamboo. Although the difference between sugar cane and bamboo in size, habit

of growth and duration of life cycle are well known and though they belong to two different sub-families of plants (Panicoidae and Poideae) yet it was realised that a certain similarity between them existed. All the same the accepted botanical principle that plants cannot be crossed outside their species or genera was demolished by the success in this crossing. Bamboo was used as a male parent, and 29 hybrids were obtained. Some of them showed characters of bamboo such as underground branching, hollow stems, nature of shoot and bud formation. Some of the seedlings were crossed again with P. O. J. 213 and the seedlings obtained were very promising. Attempts are being made to eliminate the undesirable and retain the best characteristics of the bamboo parent.

For a few years crossings and selfings are being made at Coimbatore and seeds obtained are directly sent to Shajahanpur. During the first year the seeds are simply germinated and allowed to grow in green houses. During the second year 3 rows, each 20 ft. long are sown by means of cuttings. During the 3rd year the rows are extended to 180ft. and in the 4th year the first varietal trial is done. The promising ones are then sent to other stations for further trials. The varieties obtained are called CoS. varieties. Many of the CoS. varieties are promising. Mention may be made of CoS. 19, 51, 60, 87, 109, 126, 133, 146 and 163.

Position of Cane in India.

	Imports		Exports
	1914	1937-38	1937-38.
Sugar (High grade) ...	524,000 tons.	14,000 tons.	14,000 tons by sea and 31,000 tons by land.
Sugar (other grade) ...	10,000 tons.	Less than 1,000 tons.	79,000 tons.

Areas in different provinces under improved canes.

DURING 1937-38.

Provinces	Total Acreage	Acreage under improved cane.
U. P.	2,127,000	1,405,308
Bihar	342,000	657,640
Punjab	512,000	319,200
Bengal	290,000	286,000
Madras	98,000	61,400
Bombay	75,000	22,900
Assam	39,000	15,600
Orissa	34,000	33,000

According to the report of 1937-38 the improved varieties of sugar cane (mostly Co. canes) occupied about 79% of the area under cane in India excluding the Indian States. Sugar cane cultivation in U. P. and Bihar is dominated by the Coimbatore productions which cover about 90% of the area. U. P. and Bihar have Co. 213 as universal; Co. 290 and 244 are next favourites in U.P. Co. 312, 313, and 331 are getting into cultivation. Co. 321 is also promising. The Punjab is the only sugar cane growing province where the indigenous canes are as yet cultivated over fairly large areas, occupying as much as 40 per cent of the area. In Bengal Co. 213 occupies about 80 per cent of the area under cane.

During the quarter of a century of successful pioneering at Coimbatore it is a curious fact that unfavourable circumstances which might have been expected to work against successful research have contributed largely to the triumphs achieved, not only in breeding better types of cane to suit the varied climatic conditions in India but also in breaking

all records in cross-breeding as exemplified in the sugar cane-sorghum and sugar cane-bamboo hybrids.

Important Varieties of Different Provinces.

United Provinces.

Co. 290 ...	... Medium Season.
Co. 331 ...	... Tall, drought, resistant, does not lodge, late, very hard.
Co. 312 ...	... Medium thick, late.
Co. 313 ...	... Medium thick, hard, early.
Co. 421 ...	... Medium thick, hard, late.
Co. 385 ...	... Medium thick, hard, early.

Last year the following varieties were being recommended for improved farms.

Early.—Cos. 76, Cos. 146, Cos. 163.
Co. 527.

Late.— Co. 421, Cos. 133 (Co. 312 being surpassed by Co. 421.)

For cultivators' fields.

Co. 213 (for Rohilkhand and Kumaon circle).
Co. 331, Co. 185 and Co. 210.

For ratoon crop.—Co. 313 early.
Co. 312, 421, 331 are promising.

Bihar and Orissa :—

Early.—Co. 299.

Medium.—Co. 313 and 213 are the standard.
Co. 430, 421, B.O. 3, B.O. 4 are also promising.

Late.— Co. 421, Co. 531.

Punjab :—

Early.—	Co. 313, Co. 385, Co. 396 (It is not good yielder).
	Co. 508 and Co. 511 are also promising.
Medium.—	Co. 316, good yielder but susceptible to Pyrilla.
	Co. 285 and Co. 205.
Late.—	Co. 421 and Co. 312.

Bengal :—

Early.—	Co. 381, Co. 281, Co. 508.
Mid-Season.—	Co. 270, 313, 375.
Late)—	Co. 331, Co. 421 (Replacing Co. 213)
	Co. 408,508 and 518 are still under trial but very promising.

Madras :—

Co. 419,421 and 281, Co. 508 is early and high yielder.
Co. 421 is proving good under water logged condition.

Assam :—

Co. 210,213,313,361,290,421,419.
Co. 356, Cos. 436, and Co. 432.
Co. 421, and 419 gave highest yield.

Bombay :—

Cultivators' canes: —

Co. 360, 419,414,417,426 and H. M. 320.

Factory canes :—

Co. 407,408,413,414,419,421.

For ratoon :—

Co. 419,426,360,417.

Co. 419 gives higher sugar per centage.

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"Flower in the cranied wall,
I pluck you out of the crannies
I hold you here, root and all, in my hand,
Little flower—but if I could understand,
What you are, root and all, and all in all,
I should know what God and man is."

TENNYSON.

METHODS OF MAKING JELLIES FROM DIFFERENT FRUITS.*

By

A. Dayal Chand, M.A., B.Sc. (Ag.), F.R.H.S.

3. Roselle and Guava Jelly.

It has been found that some people do not like guava jelly because it is very sweet, and others do not like pure roselle jelly because they say it is tart. So in order to meet the taste of both groups of people, a mixed roselle and guava jelly is made, which is neither too sweet nor too acid. This mixture resembles currant jelly which is very much relished.

Process: Extract roselle and guava juices separately as previously described and mix them in equal proportion. Take three pounds of this mixture, put it on the fire and when it starts boiling add an equal amount of sugar and dissolve it by stirring. Strain the syrup and cook rapidly over a strong fire until it reaches the jelling point. It jells between 220° to 222° F. Remove the kettle from the fire and pour it into sterilized hot jars and when it sets, seal it with melted paraffin.

4. Cape Gooseberry Jelly.

Cape gooseberry or Physalis Peruviana is an annual herbaceous plant. The seeds are sown in a nursery and when the seedlings are about six inches high, they are transplanted in rows five feet apart. The plants start bearirng in January and when the fruits turn yellow they are used for making jam and jelly.

Process : Sort out well developed, fully ripened, yellow coloured gooseberries, discarding the green and rotten ones. Remove the outer loose dry husk (calyx) which envelopes the fruit. Weigh and wash the fruits. Add half a pound of water to each pound of berries and cook them for about ten minutes. Strain the juice and make the pectin test.

Take the desired amount of juice in a kettle, put it on the fire and when it starts boiling, add half a pound of sugar

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* Continued from 1941 July issue.

to each pound of juice. Dissolve the sugar by stirring, allow it to boil for a few minutes, remove the scum and strain the syrup. Return the kettle to the fire and continue cocking until the jelling point is reached. Pour the boiling hot jelly into hot sterilized jars and seal.

5. Strawberry Jelly.

Process: Sort good, well ripened strawberries, clean them, and after weighing wash them thoroughly. Add a little bit of water to save them from scorching. Crush the berries and let them cook for about five to ten minutes. Strain the juice without pressing.

Take the desired amount of juice, add three-fourths of a pound of sugar to each pound of juice and a little home-made pectin. Cook the juice as directed for gooseberries.

4. Black and Red Raspberry Jelly.

Select sound raspberries and free them from stems and leaves. Weigh and wash them. Crush them and cook them in their own juice, for about five to ten minutes. Strain the juice and cook it as directed for gooseberries, adding three-fourths of a pound of sugar to each pound of juice.

7. Blackberry Jelly.

Sort out good firm berries and discard over-ripe, rotten and immature ones. Stem, clean and weigh them. Put the berries in a sieve and wash them under running water. Crush them; and because they are quite soft and juicy, cook them in their own juice for about five to ten minutes. Strain the juice and follow the directions of cooking as given for gooseberries.

8. Wonderberry Jelly.

These berries are purple, but turn darker when over-ripe. They produce deep-purple coloured jelly with a peculiar flavour.

Process: Sort, clean, weigh and wash the berrics. Crush them in a cooking pan and cook them in their own juice for about five minutes. Strain the juice and add two and a half pounds of sugar to three pounds of juice, and cook it, following the direction given for gooseberries.

9. Grape Jelly.

Grapes grown in India can broadly be classified according to their colour, into three kinds—black, green and white. Usually the green and white kinds are best suited for table use due to their sweet taste and attractive appearance. The black kind is tart and is not relished very much by the people. It can, however, be used for making jelly because it contains more acid than the other two kinds. Also it is very hardy and can grow in places where the others would fail.

Process: Select only the firm grapes and discard the rotten and fermented ones Remove the stems, weigh, and wash off the adhering dirt. Put the grapes in a kettle, crush them and cook them in their own juice for about five to ten minutes. Strain the juice without pressing. If black or sour varieties of grapes are used, add a quarter of a pound of water to every pound of fruit.

Take a desirable quantity of juice, bring it to a boil and for sweet varieties of grape add three-fourths of a pound of sugar to a pound of juice. For sour varieties use equal amounts of sugar. Dissolve the sugar by stirring. Continue cooking on a brisk fire, removing the scum when desired. Test the end point and when the juice "sheets off" from the edge of a spoon, remove the kettle from the fire. Pour the jelly in sterilized hot jars and seal.

Grape jelly is usually very clear, sparkling and of pink, rose or dark colour. It is delicious and very wholesome.

10. Currant Jelly.

Red currants make a very attractive rich red coloured jelly. Currants are very rich in acid and pectin, so there is no difficulty in making jelly from them. Currants yield very good jelly, if they are used when they are just reaching maturity.

Process: Sort out good sound and firm currants or use dry currants. Clean them from stalks, weigh, and wash them under running water. If firm jelly is required, crush the fruits with a wooden pestle until enough juice flows out freely from them to prevent burning; add more currants and cook them in their own juice. For jelly of ordinary texture add one quarter pound of water per pound of fruit and cook

until the colour of the fruit appears white. Remove the kettle from the fire and strain the juice without pressing. Several extractions may be made if required.

Take a desirable quantity of juice, bring it to a boil and add equal proportions of sugar. Continue cooking rapidly, occasionally stirring and skimming off the precipitation until the jelling point is reached. Pour the jelly in sterilized jars and seal.

11. Currant and Grape Mixed Jelly.

The mixed jelly of grapes and currants has a very desirable flavour. Extract the juices of both grapes and currants separately. Mix one part of currant and two parts of grape juice and follow the above directions.

12. Banana Jelly.

There are a number of varieties of bananas and plantains. The term banana used here refers only to the table varieties. Several varieties of bananas are rich in pectin, but poor in acid in the unripe stage. In the ripe stage, pectin dehydrolyses and the banana juice becomes poor in pectin and therefore unsuitable for making jelly. The stage at which bananas should be used, needs careful determination because if immature bananas are used, they impart an astringent taste to the jelly.

Process: Select firm but ripened bananas. Peel them and cut them into thin slices. Cook them with an equal amount of water for about twenty minutes until the slices become very soft. Strain the juice through a thick jelly-bag.

Take three pounds of juice, bring it to boil and add an equal amount of sugar. Dissolve it by stirring and then leave it unstirred until a thick layer of organic matter rises to the surface. Skim it off before the juice starts boiling again. Strain the syrup and then add 18 c.c. of 0.057 citric acid or 2 ounces of limejuice. As the banana juice is very cloudy, add one-eighths of an ounce of powdered alum in three doses to precipitate the organic matters. Remove the scum and continue cooking until the juice "sheets off" Pour the boiling hot jelly into the sterilized jars and seal with melted paraffin wax.

SOIL IMPROVEMENT BY GREEN MANURING

BY

S. Chowdhury, B. Sc. Ag., Assoc. I. A. R. I.

From time immemorial the turning under of a green crop to supply organic matter to the soil has been a common agricultural practice. Records show that the use of beans, vetches and lupine for such a purpose was well understood by the Romans, who probably borrowed the practice from nations of still greater antiquity. The art was lost to a greater extent during the Dark ages, but was revived again as the modern era was approached. At the present time green manuring is considered a sound way of improving soil fertility.

Benefits from Green Manuring :

Numerous are the benefits derived from green manuring. In the first place certain ingredients are actually added to the soil by such a procedure. The carbon and oxygen of a plant come largely from the air, and the ploughing under of a green crop therefore increases the store of these ingredients in the soil. If the plant is a legume and the nodule organisms are active, the nitrogen content of the soil is augmented. The mineral part of the turned under crop, of course, come from the soil originally and they are merely turned back to it again. As they return however, they are in intimate union with organic materials, and are thus readily available as plant food as the decay process goes on. Actual additions are thus made to the soil together with a promotion of an increased availability of the constituents dealt with.

Green manures may also function as cover crops, in so far as they take up the extremely soluble plant food and prevent it from being lost in the drainage water. The nitrates of the soil are of particular importance in this regard, as they are very soluble and absorbed only slightly by the soil particles. Besides this, green manures, specially those

with long roots, tend to carry food up from the subsoil, and when the crop is turned under this material is deposited within the root zone of the succeeding crops. Again, the added organic matter acts as a food for bacteria, and tends to stimulate biological changes to a marked extent. Then the humus that results from the decay of this organic matter increases the water holding power of the soil, and promotes aeration, drainage and granulation—conditions that are extremely important in successful plant growth.

Crops Suitable for Green Manuring :

The crops that can be used for green manuring can be divided into two distinct groups—'non-legumes' and 'legumes'. The non-legumes cannot fix free atmospheric nitrogen and when ploughed under do not add to the soil any nitrogen. They are only serviceable in preventing losses of soluble elements and in improving the physical character and absorptive properties of soil by the introduction of organic matter in the soil. The members of this group include the cereal grains, the grasses, buck-wheat, turnips, rapes and like crops.

The legumes, on the other hand, possess the power of fixing the free atmospheric nitrogen. When they are grown as green manuring crops not only the physical condition of the soil and its absorptive properties are improved due to the incorporation of the organic material but the store of soil nitrogen is also materially increased. Plants of this group are clover of all kinds, vetch, alfalfa, peas, beans, cowpeas, soybean, lupine, peanut, sann hemp, *dhaincha* and very many herbs, shrubs and trees.

When other conditions are equal, it is of course always better to choose a leguminous crop for green manuring in preference to a non-leguminous one, because of the nitrogen that may be added to the soil.

Non-Legumes used for Green Manuring :

Non-leguminous crops are rarely used for green manuring in this country ; in America they are used to a considerable

extent. The principal ones are: rye, wheat, buckwheat, mustard and turnip.

Rye: This is used in many parts cf America, primarily to prevent losses during late fall and winter. The advantages of this crop are that it grows rapidly, is a good forager and is capable of withstanding well severe weather. Its chief value, however, lies in its habit of late fall and early spring growth which holds the soil and prevents washing and mechanical losses.

Wheat: Wheat possesses the characteristics that have been mentioned for rye, though not to the same degree. The seed usually costs more, and satisfactory growth requires a better preparation and manuring of soil; besides the plant is not so hardy. It is therefore as a rule less satisfactory for the purpose than rye.

Buckwheat: This crop is used very largely for improving poor soils in America. Its season of growth is during the summer months of July and August It is able to make a relatively large growth on medium poor land. When grown as a renovating crop it improves the physical character of soils by keeping them covered during the hot season and by adding vegetable matter.

Mustard: Certain varieties of mustard are extensively used as a summer cover crop, in some countries, particularly Germany. The plant grows rapidly and is able to subsist on rather poor soils, thus accumulating in the surface soil materials more readily appropriated by other plants.

Turnip: The turnip possesses characteristics of value, owing to its rapid appropriation of food in cool weather and consequent large accumulation of organic matter in late fall. Those varieties that root deeply are preferable, because they gather a part of their food from lower layers of soil and store it in their enlarged bulbous roots near the surface; besides it exerts a favourable influence on the physical character of the soil. It causes a separation of the soil particles and permits a freer access of air.

Legumes used for Green Manuring:

A large number of legumes are used for green manuring throughout the world. Their selection depends principally on local conditions. The principal ones are :

Red Clover :—The renovating character of a crop of red clover is well known, and even when only stubble and roots are the source of the additions made to the soil, the improvement that follows is very marked. The ameliorating influence of the crop on soils is due primarily to two causes: first to the extensive root systems, which is widely distributed throughout the soil and to great depths in it, thus changing to some extent, physical character as well as storing food in a large tap root near the surface of the soil, in readily decaying organic forms; second, because the plant is a nitrogen gatherer. The wider and more frequent use of red clover can be commended from all standpoints when the increase and maintenance of natural fertility are important. Red clover should be seeded at the rate of 15 lbs. per acre.

Mammoth, alsike and crimson clovers are also used for green manuring but they are not so efficacious. Mammoth clover is better adapted to wet lands than red. Crimson clover is essentially a cool weather plant. Alsike clover has a semi-creeping habit and does well only when seeded with a kind making a more upright growth, as the red or mammoth.

Alfalfa :—Alfalfa is not adapted so well for use as a green manure, because of the expense of seeding, the difficulty of securing a stand and its comparatively slow early growth. It is a perennial which does not reach its maximum annual growth until the second or third year after seeding. If broadcasted, alfalfa may be seeded at the rate of 25 to 35 lbs. per acre, if drilled 15 to 25 lbs.

Field Pea :—Field pea thrives well in cool, moist places and does not grow well except on good soils. Its use as a green manure crop is therefore limited. The crop serves well as a mulch preventing the washing away of the soil. It should be seeded at the rate of 30—120 lbs. per acre.

Cowpea :—The cowpea reaches its best development in warm climates. The rapid and large development of the plant make it one of the most useful of the legumes for soil improvement. There is perhaps no other crop that is so generally useful for soil improvement as cowpeas. In the first place it grows during the hot summer when it is desirable to have the ground covered and its long tap root penetrates into the subsoil, loosening it and making it more porous and in the second place, the absorption and assimilation of nitrogen renders it of great service when the crop is used for forage and only the roots and stubble are left as additions to the soil. It may be sown at the rate of 60 to 90 lbs. per acre.

Soybean :- Soybean resembles the cowpea in many of its characteristics but it is slightly more difficult to handle than the cowpea, and the yields are not so heavy though the plant contains more nitrogen in the dry matter. Many prefer it however to the cowpea because the plant is easier to cover completely in ploughing ; a large crop of cowpea is particularly difficult to plough under. The seed rate is the same as cowpea.

Boga-medeloa (*Tephrosia candida*) :—This leguminous shrub is grown very widely as a green manuring crop in the tea gardens of Assam and gives a good return within two or three years. The roots of the plants are well furnished with root nodules, a sign that it actively fixes the nitrogen of the atmosphere. This is also indicated by the richness in nitrogen of the prunings obtained from growing bushes. A set of such prunings obtained from three year old plants and containing an abnormal quantity of woody matter gave 3·49 per cent of nitrogen, calculated on the dried material. It is a most valuable plant for green manuring as it can be grown on any kind of soil and seems even to thrive best upon poor dry land where other green manuring plants can hardly be got to grow at all. An important fact also is that the bacteria are attracted to this plant most readily as the nodules begin forming upon the roots by the time that the plant is but six inches high.

Kolinji (T. purpurea) :—In the extreme south in Madras *kolinji* is used as a green manuring crop for the

main crop. As soon as the *pishanum* paddy is harvested in February, March or April, the land is ploughed and prepared immediately after the first showers of rain in April and May the seed of *kolinji* sown. The crop is allowed to grow till August or September when the crop is once ploughed through in order that weeds may be destroyed and the soil aerated. *Kolinji* is deep-rooted, consequently very little is uprooted by the plough and the uninjured plants grow much better. In October the plots are flooded and the *kolinji* ploughed in puddle. This plant grows best in light loam soils. It does not thrive well in stiff clays or land which is waterlogged.

Dhaincha (Sesbania cannabina):—*Dhaincha* has been found a very useful green manuring crop. It can withstand severe drought and will also grow in badly drained land and in soil which is slightly saline. If there is only sufficient moisture for the seed to germinate, the crop does not require any irrigation. It can be ploughed in within three months or it can be left on the ground, where it will continue to grow for five or six months, and cattle do not care for it when grown up. Thus it is very useful on uncertain double crop lands If there is sufficient water for a first crop it can be ploughed in, if there is not it can be left to grow until the season for planting the second crop. "*Takka poondu (Dhaincha)* was grown on an care of poor, badly drained and slightly saline land, which gave a yield of 924 lbs. of paddy per acre the year before. The land was ploughed after the paddy was harvested in February and the seed of the *takka poondu* was sown broadcast being covered by a second plough. The crop was ploughed in June being then 5 to 8 feet high. The yield of paddy obtained was 2086 lbs. per acre. The cost of growing the green manure was Rs. 6-11-2 per acre, while the value of the increase in the paddy crop was (at 10 Madras measures per rupee) Rs. 46 per acre". If grown a second year on the same land, *dhaincha* grows much more luxuriantly than in the first year.

Sann hemp (*Crotalaria juncea*):—Sann, hemp though is produces a fair amount of vegetable matter, does not do so well as *dhaincha*. It does better on lighter types of soil where water-logging is not likely to occur. It cannot com-

pete with *dhaincha* on stiff land and in districts of heavy rainfall.

Sann hemp is commonly grown at a time when rainfall is available for its growth and also for its subsequent decay and incorporation with the soil. Sann hemp grows very rapidly, chokes all weeds, and moreover does not require any special soil preparation. The rapidity of germina ion and the rapid growth of the tap root enables the crop to reach the subsoil moisture quickly and to survive without difficulty a break in the rains. Green manuring with Sann hemp for tobacco has been found very effective and profitable.

Experiments with Green Manuring Crops in India:

Experiments have been done with a number of green manuring crops in India. Possibly the crop of most universal use is sann hemp. Madras reports the largest number of effective green manuring crops, sann hemp, *dhaincha*, indigo wild indigo, *pillipesara* (*Phaseolus trilobus*), horse gram (*Dolichos biflorus*), cowpea. Actual comparison in value appear difficult as each thrives in rather different conditions, though sann hemp and *pillipesara* appear under general conditions the widest used. *Dhaincha* is suggested for heavy and slightly saline tracts, wild indigo where the soil is poor. *Pillipesara* appears a green manuring plant which might have wider application. In many respects it appears an ideal plant for the purpose.

In the Central Provinces sann hemp, *dhaincha, tarota* (*Cassia occidentalis*) and *kadojira* (*Vernonia cinerea*) the first three leguminous and the last a *Compositeae* have been used. The result from the first, third and fourth are somewhat similar.

At Pusa sann hemp, cowpeas, meth, (*Phaseolus aconitifolius*) and guar (*Cyamopsis psoralioides*) have been tried with slight advantage showing in favour of sann hemp.

Velvet beans have proved an easy growing and easily decomposable green manure in Mysore, where in estate practice *Crotolaria striata*, *C. trifoliata* and *Tephrosia candida* are freely used to provide mulches. The first two

are also used in the heavy rain areas to provide green manure for paddy.

Bombay reports that *kulthi* (*Dolichos biflorus*) and niger gave better results on sugarcane, paddy and maize than sann hemp and suggests *dhaincha*, wild indigo, and *Ipsemea carnea* for swamp rice.

Dhaincha and cowpea are advocated in Assam for acid soils and sann hemp and soybean where the soil is normal or lime. *Dhaincha* appears of doubtful value.

In the Punjab *sangi* has proved particularly valuable in improving alkaline soils and *guar* grown on fertile land and incorporated on poor soils has been most effective.

Points Desirable in a Green Manuring Crop:

The following points are desirable in the crop used for green manuring, though few, if any, of such crops comply with the standard in all respects:

(1) A leafy habit and heavy growth.

(2) A soft, non-fibrous character indicating rapid decomposition.

(3) A deep root system opening the soil.

(4) A good nodular growth, as indicative of rapid nitrogen absorption.

(5) A rapid early growth.

Taking green crops generally dhaincha (*Sesbania cannabina*) *bawchi* (*Psoralea corylifolia*) and cowpea comply with the first condition; cowpea, *kulthi* (*Do'ichos biflorus*) and *kadojira* (*Vernonia cinerea*) the second; *dhaincha* and *tarota* (*Cassia occidentalis*), the third; *dhaincha*, sann hemp, and wild indigo the fourth; sann hemp, kadojira and tarota the last.

Quantities of Plant Constituents Added by Green Manuring:

In an average crop of green manure from five to ten tons of material is turned under. Of this from one to two tons is dried matter, and from four to eight tons water. Of this dry matter a great proportion is carbon, hydrogen and

oxygen—a clear gain to the soil in so far as these constituents are concerned. The amount of nitrogen added to a soil if the green manure is a legume is a difficult question to decide. Much depends on the virulence of the organisms occupying the nodules. These bacteria are in turn much influenced by plant and soil conditions. Hopkins estimates that about one-third of the nitrogen in a normal inoculated legume comes from the soil and two-thirds from the air. He also considers that one-third of the nitrogen exists in the roots. It is evident, therefore, that in general the nitrogen found in the tops will be a rough measure of the nitrogen fixed by the soil organisms. The following table shows the nitrogen and organic matter that are contained in an ordinary crop of the various plants:

	Tons per Acre Green.	Nitrogen Lbs.	Organic Matter Lbs.
Cowpeas	6	48	1920
Soybeans	6	60	2640
Crimson Clover ...	6	60	2160
Alsike Clover... ...	6	60	2640
Red Clover	6	60	2400
Canada Field Pea ...	5	50	2200

If the amounts of nitrogen indicated in the table as contained in a crop that can be harvested were all gathered from the air, there would be an undoubted increase in the fertility of the soil, as the amount of nitrogen gathered is equivalent to that contained in 320 to 400 pounds of nitrate of soda, which would be regarded as a heavy dressing even for vegetable crops. Interpreted in terms of farm manures, the nitrogen and vegetable matter would be equivalent to six to eight tons of average farm manures. It must be remembered too that the yields given are not large, and that

they do not include the amount of nitrogen and organic matter that may be contained in the roots and stubble, which in the case of the clovers, is very considerable.

Importance of an Abundance of the Mineral Elements:

It does not follow, however, even when the nodule organism are present in the soil, that all of the nitrogen contained in the crop of the legume has been gathered from the air, as it has been shown that the plants will preferably take soil nitrogen; and therefore, on good soils, well supplied with nitrogen, the proportionate amount of nitrogen drawn from the air will be much less than will be the case when the crop is grown on soils poor in nitrogen.

It has been demonstrated that the proportion of nitrogen gathered by the plant from the air, particularly on poor soils, will depend on the supply in the soil of the other necessary plant food ingredients. That is, soils poor in nitrogen and often poor in physical character, if not well supplied with the minerals, phosphoric acid and potash, will not produce a large crop of cowpeas or soy bean or any other leguminous plants because its growth and development depends on the ease with which it may acquire the necessary amount of these other elements of nutrition. Hence in attempts to build up poor soils by means of green manure crops, it is quite as necessary to manure the soil with the minerals in order to insure maximum growth as it would be in order to grow any other crop. This is entirely reasonable as the mineral constituents cannot be secured from any other source than the soil, and they are quite as essential in the complete growth and development of a crop as is the nitrogen.

The point is that green manuring does not result in building up and making better a soil that is naturally poor in the mineral constituents. It can contribute only the nitrogen and that in itself is not a complete food: it is only one of the elements.

Soil and Green Manuring :

There is a general acceptance that green manuring is at its highest value on the lighter types of soil and least so when these are heavy and tend to crack liberally. On soils of the lighter type green manuring gives a better return than equal quantities of nitrogen as manure. In Madras the quantity applied in paddy ranges between 4,000 to 6,000 of green matter. The return of the heavy black soils of the Godavari where the ordinary practice is to leave such soil untouched in the dry season show a gain of 8 to 10 per cent. from green manuring, while on lighter grades the increase ranged from 20 to 25 per cent. The increase on sugarcane in the United Provinces on the inversion of an average crop of sann hemp is reckoned at 20 to 25 per cent and on wheat under suitable conditions of use at 12 to 15 per cent.

Ploughing in of Green Manures :

A point that should be clearly understood in the matter of soil improvement by means of green manures is the time of ploughing in the crop. In the first place, the character of soil exert an influence on this point. As a broad general rule, there is danger of injury to light soils in ploughing in a heavy burden of green material, particularly in warm weather whereas on heavy soils the danger is very much less and in fact ordinarily very remote.

It is generally best to turn under green crops when their succulence is near the maximum. When a green crop is allowed entirely to mature, it not only draws heavily on the available food constituents of the surface soil, but rapidly and often completely exhausts it of moisture. Therefore, if ploughed in its mature state, it will result in leaving between the surface and the subsoil a mass of vegetable matter not readily broken down, thus cutting off the connection between the surface and the reservoir of water lying below. Should dry weather follow, the decay will be very slow, and the succeeding crop will have only the food and the moisture that are contained in the surface soil turned over, and from this the available food and the moisture have been largely extracted by the maturing of the large crop of green manure.

A large quantity of water is introduced into the soil when the green manure crop is turned under at the maximum state of succulence. Again the succulence encourages a rapid and more or less complete decay, with the maximum production of humus and end products. The crop should be ploughed in, if possible, at a season when a plentiful supply of rain occurs. The effectiveness of the manuring is thereby much enhanced.

Use of Lime:

The decomposition of organic matter in the soil is always accompanied by the production of organic acids. Such acids tend to form in large amount especially if the fermenting matter is of a succulent nature. The need of plenty of lime under such conditions is clearly apparent, as a soil of a neutral or an acid character may assume a bad condition during the process of humic decay. Lime may be added to the green manuring seeding and be turned under with that crop. But it is not necessary that it should be applied in all cases, since the application of say, 25 maunds of stone lime per acre in a rotation once in four years, would be likely to meet all the needed requirements for lime.

'Time Factor' in Green Manuring:

It became evident during the early years of the present century in India, that no matter what the rainfall and the soil conditions may be a definite '*time factor*' is in operation in green manuring. A period of not less than eight weeks must elapse between the ploughing in of the green crop and the planting of the next if satisfactory results are to be obtained. This was well brought out in the green manuring experiments on tobacco carried out at Pusa between 1912 and 1915. Some years later the explanation of this factor, as well as the general condition necessary for the decay of a green manure crop were furnished by the work done at the New Jersey Experiment Station by Waksman and his co-workers. The decay and incorporation of green manure in the soil has been shown to be a very complex process, depending on: (1) the chemical composition of the plants

which make up the green manure, which in turn largely depends on the age of the crop when ploughed in; (2) the nature of the decomposition of the various groups of organic complexes in the plant by the different types of soil organisms which in turn is influenced by such factors as moisture, aeration and the supply of available nitrogen and phosphates needed by the organisms, and (3) the metabolism of the micro organisms taking part in the decay of the green crop.

"The process of the incorporation takes place on the following lines. When the green manure crop is ploughed in, the first stages of decay are brought about by fungi, which require for their activities ample supplies of air, moisture and combined nitrogen, as well as the soluble and easily decomposable carbohydrates supplied by the green crop. If the supply of nitrogen provided by the green manure is insufficient the stores of soluble nitrates in the soil solution are utilised by the fungi. Decay is rapid provided all these essential factors are simultaneously arranged for. The result is that the whole energies of the soil at this period are given up to the needs of the fungi of decay, which synthesize large quantities of protoplasm from the materials supplied by the green crop and the soil solutions. During this phase, most of the nitrogen present is built up into mycelial tissue and is therefore not immediately available for the growth of crops. The next stage is the decay of the remainder of the green manure including the mycelial tissue itself, by various groups of bacteria, followed by the incorporation of the whole mass into the soil organic matter. This must first be nitrified before the soil solution and the crop can obtain any benefit from this form of manuring. Clearly all this takes time, and needs abundance of oxygen as well as a continuous supply of soil moisture. If any of the limiting factors...nitrogen supply, air or moisture... are in defect, it is obvious that the final stage of nitrifiable organic matter will not be quickly reached. The soil will not only contain a mass of undigested material, but will be poor in available nitrogen and perhaps low in moisture as well. Seeds sown in such a soil can only result in a poor crop." The investigations of the New Jersy Experiment

Station clearly explain the importance of the *'time factor'* in green manuring

Importance of an Abundance Supply of Moisture:

At the end of the last century it seemed so easy, by merely turning in a leguminous crop to settle at one stroke and in a very economical fashion the great problem of maintaining soil fertility. At the expenditure of a very little trouble, the soil might be made to manure itself A supply of combined nitrogen, as well as a fair quantity of organic matter, might be provided without any serious interference with ordinary cropping. These expectations have led to innumerable green manuring experiments all over the world with practically every species of leguminous crop. In a few cases, particularly on open soils and where the rainfall, after the ploughing in of the green crop, is well distributed, the results have been satisfactory. On rice lands where abundance of water ensures the maintenance of swamp conditions somewhat similar results have been obtained. In the vast majority of cases, however, green manuring has been disappointing. On the monsoon fed areas of India the rainfall is often so uncertain, after the green crop is ploughed in, that for long periods decay is arrested. Sowing time arrives at a stage when the soil contains a mass of half-rotted material, with insufficient combined nitrogen and moisture for the growth of a crop. Failure results. The crops raised after green manure are worse than those obtained on similar land left fallow. Lack of sufficient moisture in the soil is mainly responsible for such failures. Experiments of Clarke at Shahjahanpur clearly explain the necessity of sufficient moisture in the soil for successful green manuring. The secret of Shahjahanpur process is to provide ample moisture, by means of irrigation. for the first stages of decay of the green manure. The rainfall, after the (sann) hemp crop is ploughed in, is carefully watched. If it is less than five inches during the first fortnight of September, the fields are irrigated. This enables the first phase of the decay of the green crop by the soil fungi to be completed. Practically all the nitrogen is then in the form of easily decomposable mycelial tissue. During

the autumn, nitrification is prevented by drying out the surface soil. The nitrcgen is, as it were, kept in the bank till the sugarcane is planted under irrigation in March. Nitrification then sets in and the available supply of combined nitrogen are made use of by the sugarcane. In this way crops of over thirty tons of cane to the acre have been grown without the addition of any manure beyond the hemp, grown on the same land the previous rains and treated in the manner indicated above.

Decomposition of Plant Substances and Nitrogen Transformation:

Hutchinson and Milligan carried out laboratory experiments on the decomposition of sann hemp at various stages of growth and under different conditions in Pusa soil. They considered the quantitative transformation of nitrogen alone. Joshi's work was on the comparative rate of nitrification of different green manuring plants and the different parts of the plant used as green manures in Pusa soil. He found from his experiments that the more tender and hence more easily decomposable the tissue, the slower the nitrification. Waksman has, however, recently observed that plant materials decompose more readily (in the form of ammonia) at an early stage of growth and less so when the plant is matured. " At an early stage of growth, the plant is rich in water-soluble constituents, in protein and is low in lignins. When the plant approaches maturity the amount of the first diminishes and the second increases. The water-soluble constituents, the proteins and even the pentosans and cellulose decompose very rapidly provided sufficient nitrogen and mineral are available for the micro-organisms. The lignins do not decompose at all in a brief period of time of one or two months. More so their presence has even an injurious effect upon the decomposition of the celluloses with which they are combined chemically or physically. The larger the lignin content of the plant the slower does the plant decompose even when there is present sufficient nitrogen and minerals.

" It has been shown repeatedly that the organisms (fungi and bacteria) decomposing the celluloses and pentosans require

a very definite amount of nitrogen for the synthesis of their protoplasm. Since the cell substance of living and dead protoplasm always contains a definite, although varying, amount of nitrogen and since there is a more or less definite ratio between the amount of cellulose decomposed and the cell substance synthesized, depending of course upon the nature of the organisms and environmental conditions, the ratio between the cellulose decomposed and the nitrogen required by the organism is also definite. This nitrogen is transformed from an inorganic into an organic form. Of course in normal soil in the presence of the complex cell population, the cell substance soon decomposes, a part of the nitrogen is again liberated as ammonia and a part remains in the soil and is resistant to rapid decomposition. The amount of nitrogen which becomes available in the soil is a balance between the nitrogen liberated from the decomposition of the plant materials and that absorbed by the micro-organisms which decompose the nitrogenous and non-nitrogenous constituents. The younger the plant, the higher is its nitrogen content and the more rapidly does it decompose, therefore the greater is the amount of nitrogen that becomes available. The lower the nitrogen content of the plant the less of it is liberated and the more of it is assimilated by micro-organism."

Experiments of Bal indicate that the earlier sann hemp is used as green manure the more rapid is the decomposition of its carbonaceous and nitrogenous constituents. With *dhaincha*, however, there was no marked decrease in the rate of nitrification of the comparatively older plants, though there was a certain amount of decrease in the decomposition of carbonaceous constituents. He also found that nitrogen on the leaves of sann hemp is more easily nitrified than that in stems: stems of sann hemp do not appear to have any retarding effect on the decomposition of sann hemp leaves in black cotton soil.

Effective Utilisation in Practice :

The following may be taken to be established governing the effective utilisation of green manure in practice:

(1) that unless a green manure can be sown under irrigation before the rains, sowing should be done as soon as possible after the monsoon is established ;

(2) that the date of inversion should be as far advanced as to secure as large a body of material as is consistent with (except in the case of paddy) the full decomposition of the green manure before the planting of the crop;

(3) that green manuring is not an effective practice if for any reason there is not likely to be sufficient security in the existence of enough moisture to effect decomposition and to meet the water needs of the subsequent crops;

(4) that the time which must be allowed between inversion and sowing will vary with the green manure employed, the crop following and the date of planting of that crop, but that it should be no earlier than the time required for the decomposition of the crop ploughed under.

The Comparative Value from the Point of View of Nitrogen Recuperation of Different Leguminous Crops when grown in Rotation:

In this connection very little is known except that of Bal of the Central Provinces. Results of Bal coincide with results attained earlier in long continued rotational experiments in the province, that is in the case of *kharif* crops, cotton yields following sann hemp and groundnut were invariably better than when following other leguminous or non-leguminous crops: while in regard to the *rabi* rotations the yields of wheat had been better maintained after *lakh* than gram and that in both these the general soil fertility as measured by the wheat crops secured showed little or no fall after 20 years of rotation while the yield of wheat without rotation and wheat after linseed had depreciated heavily. An experiment of long standing in Mysore comparing *Dolichos lablab*, *Cajanus indicus* and groundnut

had shown a 30 per cent increase in *rabi* after the last named as compared with the two former. The marked value of the groundnut as a recuperating crop is also noted in Madras. The possibility of not merely maintaining but increasing fertility by judicious inclusion of leguminous crops used as green manures or fodders has been shown by Sayer.

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"If perfection and not pleasure be the goal, then this universe had to be a universe of discipline, of pain and even hardness I need this kind of a school if my graduation means *that*."—STANLEY JONES.

It would be interesting to figure out just how many foot-pounds of energy men have saved themselves, since the creation of the world, by keeping up the pretense that a special knack is required for washing dishes and for dusting—and that the knack is wholly feminine.—HEYWOOD BROWN.

"INCREASE IN YIELD OF MAIZE DUE TO HYBRID VIGOUR"*

By

RAZI HAIDAR NAQVI, B. SC. (*Agri.*)

(Agricultural Research Institute, Sabour, Bihar)

In my previous contributions, sufficient light has been thrown on the maize strains of the Botanical section, Sabour. It has been mentioned there that they have been made pure after seven or eight years of selfing. The selfed strains exhibit their true characters but the ears become small and have reduced number of grains in their rows resulting in considerably lower yields as against the unselfed strains of the same variety. On the actual examination of selfed cobs, it is found that in some cases there is no setting of grains to a distance of about an inch or so from the tip downwards and sometimes the grains in other places are also missing. The selfed cobs when compared with the unselfed cobs of the same variety appear to be definitely inferior, but so much pains are taken in making them pure for fertilising the silk of one strain with the pollen of the other desirable selection. This phenomenon is technically known as crossing and the plants raised from the resultant cob are called "hybrids". The hybrids have the capacity of remarkably out-yielding one or both the parents separately and this quality of giving higher yields in the hybrids is termed as 'Hybrid Vigour'. In some of the foreign countries in general, and America in particular, enormous profits are derived by growing maize hybrids and hundreds of maunds of hybrid seed is distributed to the cultivators every year.

In our country, there is so much of natural crossing that the crop does not remain pure and hence there is a constant

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deterioration in the yielding capacity of maize. In Bihar, besides the improvement in yield, there are certain specific problems which need a proper solution. For "diora" (low) lands such varieties are required which either ripen before these low lands actually get flooded in the rainy season or are flood resistant. Experiments which were conducted this year to examine the capacity of the existing strains to tolerate standing water throughout their life-cycle did not give encouraging results and hence it is essential to divert our activities in some other direction to solve the problem under question. Maize hybrids combine the quality of giving higher yields with early maturity. With a view to obtain an early ripening hybrid, some of the foreign early varieties that were being acclimatised were crossed with the early maturing Bihar strains, the details of which are presented below:—

1. Sabour Local × North Western Dent,

2. Dumka × Golden Glue,

and 3. Godda × Longfellow Flint.

For the purpose of this brief note, the details of only the first cross are being presented here. The general observations showed that the hybrids, throughout their life cycle were more promising and healthy than their parents. They ripened somewhat earlier and gave a higher outturn. For detailed comparison of the hybrids with their parents, the hybrids and the parents were sown side by side in separate lines. The hybrids were in the middle whereas Sabour Local was on one side and North Western Dent on the other side of the hybrid line. Proper records were taken for such characters as vegetative growth, flowering notes and the ear measurement, etc. The detailed data presented below shows the definite superiority of the hybrids over their parents.

TABLE I.

Average Height of Plants.

(15 days interval after germination.)

Variety of Maize	29th June, 1940.	14th July, 1940.	29th July, 1940	13th August, 1940.
Sabour Local ...	35 cms.	93 cms.	196 cms.	202 cms.
North Western Dent.	44 „	119 „	159 „	171 „
Hybrid ...	53 „	128 „	203 „	207 „

From the above data it is abundantly clear that the hybrids are taller from the very beginning and that this increase in height continues to be more than both the parents separately throughout their life cycle. This clearly shows that the hybrids have the capacity of being taller than their parents.

TABLE II.

Statement showing Flowering Dates.

Variety of Maize.	TASSEL.			SILK.		
	First Flowering.	General Flowering.	Last Flowering.	First Flowering.	General Flowering.	Last Flowering.
Sabour Local.	19th July, 1940.	22nd July, 1940.	7th Aug., 1940.	28th July, 1940.	28th July, 1940.	12th Aug., 1940.
North Western Dent.	12th July, 1940.	19th July, 1940.	25th July, 1940.	18th July, 1940.	26th July, 1940.	26th July, 1940.
Hybrids	15th July, 1940.	17th July, 1940.	22nd July, 1940.	23rd July, 1940.	28th July, 1940.	30th July, 1940.

There are very few plants that flower early and similarly there are a few others which flower late and hence the middle columns in the above table represent the general flowering dates. From the above data it appears that

there is not much of difference in the flowering dates of the hybrids and the parents although the hybrid very often flower and ripen much earlier. A number of crosses have, however, been made this year and it is expected that more light will be thrown on this aspect of the problem the next year.

TABLE III

Detailed Ear Measurements and Yield.

Kind of Maize.	Average Yield of 17 plants.	Average Length of Ears.	Average Thickness of Ears in cms.			Average number of grains per Row.
			Tip.	Middle.	Butt.	
Sabour Local..	15·5 ch.	14 cms	1·5	3·2	3 4	19
North Western Dent.	9·5 ch.	14 cms.	2·7	3·4	3·7	32
Hybrid ..	1 seer 8·5 ch.	22 cms.	2·4	4·1	4·6	44

From the above table, it is evident that the ears from the hybrid-plants are longer and thicker than the ears of the parents and consequently possess more number of grains per row. The improvement in all these characters has resulted in increased yield. Besides the characters mentioned above, the increase in yield in the hybrids is also due to much bigger, thicker and broader grains of the hybrid as against their parents.

The Department of Agriculture has all along been busy with beneficial researches in order to find out ways and means of improving the lot of the cultivators, but it is up to the cultivators to derive benefit out of such a useful work. Our Department of Agriculture has four rangers and in case the cultivators and the zamindars of each range decide to grow only one variety in their range according to their requirements and thereby reduce the chance of so much of inter-crossing, they are sure to get higher yields with pure seed. Besides this they may also get a regular supply of hybrid seed and get higher yields from their fields without incurring any extra expenditure over its cultivation.

VERNALIZATION

By

S. R. Barooah, B. Sc. (Ag.).

Institute of Agricultural Research, Benares Hindu University.

The most remarkable achievement in agriculture during recent years has been the Russian discovery that by suitable treatments of seeds before sowing, crop production can be greatly hastened. Professor T. D. Lysenko of the Odessa Institute of Plant Breeding discovered the process in about 1928 and called his method "Jarovizacii" in Russian, though it is now more widely known by its Latinite form "Vernalization". With the extension of cultivation to the Arctic regions where it has hitherto been a hazardous task, the cultivation of spring wheats in the semi-arid zone of the Ukrainian steppes where high temperatures damage the crops just prior to heading, the possibility of growing more than one generation of plants within the same year and the general improvement in yield and in quality are amongst others a few of its accomplishments.

Theory—The main principle behind the Lysenko's theory of vernalization is that in the life of a plant there are a series of separate stages which always proceed in a strict sequence and a subsequent stage can not set in until the preceding stage has been completed The separate stages require different conditions for their completion, the important stages being "thermo-stage" and "photo-stage". In the thermo-stage the temperature is the main factor: if this is not supplied, then the plants will not develope. The next stage is called the photo-stage because the governing factor here is the length of illumination per day, and the temperature variations do not matter very much. Completion of the photo-stage requires first the completion of the thermo-stage and then the appropriate length of illumination, the

intensity of light being of no consequence. If these two stages are fulfilled then the plants will produce seed, otherwise not. On this principle the practice of Lysenko's vernalization is based. The theory is now corroborated by almost all the workers on this line, though some of them have offered certain modifications to this theory. Thus vernalization—the treatment of seeds before sowing—must have completed these two stages before they are said to be vernalized.

History and Method—Gassner in 1918 showed that if the germinating seeds of winter cereals be kept at a temperature near freezing point for about a month and then sown, the plants mature early. This method as such is quite impracticable for cultivators' purposes as the seedlings become too large to be handled. Lysenko hit upon the idea of retarding their growth by limiting the supply of water. The seeds then remain fit to be sown in the usual way and can even be dried and stored for a time. The precise method of vernalization varies with different plants and also with different varieties of the same plant. To be successful in this act it is therefore necessary to determine the exact condition of each form. Winter wheats are vernalized by first soaking in water, but the weight of the absorbed water should not be more than 50 per cent of the dry weight of the seed. The seeds are kept in this water for one or two days at room temperature when they get swollen and the embryos begin to emerge from the seed coat. They are then kept in darkness at a temperature of 35—36° F. (near freezing point) for 40 to 50 days. After this period the process of vernalization is complete and the seeds are ready for sowing. The best results are obtained if the seeds are sown immediately after vernalization and therefore treatment should be started at such dates that the vernalization is finished on the day of sowing. If absolutely necessary, vernalized seeds may be dried for storage by adding about 30 per cent more dried seeds of the same variety, but in no case should they be kept for more than 15 days before sowing.

The vernalized seeds are outwardly quite similar to the unvernalized ones, but differ qualitatively from the

latter. The precise nature of this qualitative change is not known. One school of thought says that it is due to the enzyme, while another school believes that hormones are the causal agents. But there is no doubt that a change of the colloidal and chemical nature of the protoplasm takes place during vernalization as it is proved by the fact that the vernalized and unvernalized seeds react differently to certain stains. Thus, it is only with stains that a seed can be detected whether it is vernalized or unvernalized.

Practical Utility.—The method is widely practised in Russia. By this process winter cereals can be made to yield if sown in spring. And in the case of the spring varieties the great hastening of seed formation makes it possible to obtain two crops in the same season. It has also made it possible to grow high yielding late varieties in dry regions like the Ukraine where they are usually destroyed by heat and drought. Due to the great hastening of crop production by vernalization successful cultivation even in Arctic regions is now made possible, where very little agriculture was prevalent due to heavy snow. The yields from the vernalized plants is also much greater. At Odessa it has been found that in two varieties of wheat imported from outside the yield is 25 per cent more when vernalized, and also it is much more than the best local variety grown normally. Not only yield but other qualities such as drought resistance, size, quality and weight of the grains are also increased as shown by the results obtained with all the varieties of wheat collected all over the world. Milling and baking qaulities are also much improved. Soya bean cultivation had been impracticable in Germany and England due to the long days prevalent when the plant grows. After vernalization they grow very well in the summer and there is no need to grow them in warm green houses during the short days of winter Results with other crops had been equally encouraging. In oats the increase in yields was 22 per cent. Rice in Holland showed earlier tillering (branching at the base) and the yields were 18 and 14 per cent more in the case of grain and straw, respectively. Potatoes in the central Volga region made the crop mature one month

earlier, and the yield was 10 per cent more than usual. To plant breeders vernalization has been an invaluable asset, they can obtain even 3 generations of winter wheat and four of spring variety in one year by vernalization combined with artificial control of the length of day. But not much work seems to have been done to test the ability of the vernalized plants to resist diseases. However marvellous results have been achieved in other respects by the use of this method, in foreign countries.

While results obtained in Russia are so striking they are less encouraging in other countries under different climatic conditions or with other crops. In India the results so far have not been promising. At Pusa two varieties of wheat and barley were vernalized and sown. With wheat there was not much change; but barley, when vernalized for one week, showed accelerated maturity. Oats also showed an accelerated maturity of 1 to 6 days. Cotton and sorghum when vernalized in Nagpur did not show definite results but in some cases the latter showed an acceleration of 3 to 4 days in maturity. Against the failures from different places it will be interesting to note the results recently published from the Vivekananda Laboratory, Almora, by B. Sen and S. C. Chakravarty. They have obtained good results with mustard.

Vernalization was not widely practised in Russia till 1932 when the area under vernalized crops was about 86,000 acres. In 1933 it rose to about 400,000 acres and in 1934 the figure reached to about 2 million acres. Unfortunately not many attempts have been made in India and positive results have not been obtained. A suitable technique of vernalization for a particular crop is beset with considerable difficulties and to this is added our ignorance of the developmental features of tropical plants and of the environmental factors influencing them. These two reasons together would account to a great extent the failure of experiments made in India.

Future Prospect.—One of the chief difficulties of the agriculturists in India is to fight against the uncertainties of weather conditions. Excessive rain or high temperatures often

do not permit crop to stand in the field for a long time. Raids of frequent floods in the fertile lands of India are too well known. Under these adverse conditions of agriculture it will be a great boon to the agriculturists if the crops could be harvested in a very short time during which unfavourable weather conditions might not set in. Some of the difficulties in agriculture could certainly be overcome by the method of vernalization. Hence it is very desirable that some workers having developed a suitable technique should take up the problem of vernalization of crops like rice, wheat, cotton, jute and others, which have been successfully vernalized by workers outside India. Let us hope for a better prospect of vernalization in India.

"TEN COMMANDMENTS"

1. Work hard. Hard work is the best investment a man can make.

2. Study hard. Knowledge enables a man to work more intelligently and effectively.

3. Have initiative. Ruts often deepen into graves.

4. Love your work. Then you will find pleasure in mastering it.

5. Be exact. Slipshod methods bring slipshod results.

6. Have the spirit of conquest. Thus you can successfully battle and overcome difficulties.

7. Cultivate personality. Personality is to a man what perfume is to a flower.

8. Help and share with others. The real test of business greatness lies in giving opportunity to others.

9. Be democratic. Unless you feel right toward your fellowmen, you can never be a successful leader of men.

10. In all things do your best. The man who has done his best has done everything. The man who has done less than his best has done nothing.

CHARLES M. SCHWAB.

ALLAHABAD AGRICULTURAL INSTITUTE

ALUMNI NOTES

BY

S. R. MISRA, B. A., DIP. AGR.,

Secretary, Alumni Associaton,
Allahabad Agricultural Institute.

After the last Annual Meeting of the Institute alumni held in November, 1940, the Executive Committee of the Alumni Association sent a circular letter dated February 24th, 1941, enclosing the proposed constitution and the membership forms to a large number of the alumni. The response of the alumni has been encouraging. Up to the present time sixty members have been enrolled and it is not too much to hope that the number of the members would be doubled before the next annual meeting. Quite a few of the enrolled members have contributed small donations also to the Association.

ALUMNI WHO VISITED THE INSTITUTE

During the last six months the following alumni paid a visit to our Alma Mater :—

Mr. A. K. Mallik, M. Sc., B. Sc. (Ag.,) Assoc. I.A.R.I., of the class of 1934, Assistant Meteorologist, Poona. The visit was made last Christmas while on his way to the Indian Science Congress held at Benares.

Mr. M. M. Qureshi, B. Sc. (Ag.), of 1938, Entomological Assistant, Government Farm, Dacca, Bengal.

Mr. Shahzor Singh, Dip. Ag., of 1921, Agricultural Supervisor, Salvation Army, Moradabad, U. P.

Mr. B. M. Gupta, B. Sc. (Ag.), of 1939, a Research scholar of the Imperial Agricultural Research Institute. He visited us while on his way from Pusa to New Delhi.

Mr. John Bairagi, Dip. Ag. of 1923, of Fiji Islands and now student of the Theological College, Serampore. He stayed here from April 2nd to 9th.

Mr. K. K. Misra, B. Sc. (Ag.) of 1937, Teacher, Rajkumar College, Raipur.

Mr. N. R. Dey, B. Sc. (Ag.) of 1940, Research student, Mycology Section, Imperial Agricultural Research Institute, New Delhi.

New Appointments

Mr. K. K. Misra, B. Sc. (Ag.) of the class of 1937 was appointed Agricultural teacher, Rajkumar College, Raipur, C. P., in January, 1941.

Mr. B. B. Singh, B. Sc (Ag.), of the Intermediate class of 1937 was appointed Agricultural Officer, Sarguja State, C. P., in March 1941.

Mr. B. M. Gupta, B. Sc. (Ag.), of the class of 1939, is now Research Assistant, Mycology Department, Imperial Agricultural Research Institute, New Delhi.

Mr. C. W. Dover, B. Sc. (Ag.), of the class of 1936, is now Assistant in the Animal Husbandry and Dairy Department of the Allahabad Agricultural Institute. Mr. Dover after passing from here took his Post Graduate course in Animal Husbandry and Dairying at Bangalore.

Mr. Ram Sarup, I. D. D., of 1938 was appointed as milk recorder for the Imperial Council of Agricultural Research, New Delhi, in May, 1941.

Mr. M. A. Samuel, B. Sc. (Ag.) of the class of 1939, and a Post Graduate of the Imperial Dairy Institute, Bangalore, was recently appointed Assistant in the Animal Husbandry and Dairy Department, Allahabad Agricultural Institute.

Marriages

Mr. H. R. B. Pingle, B. Sc. (Ag.), of the class of 1939 got married in March, 1941.

Mr. J. C. Barpujari, B. Sc. (Ag.), of the class of 1940 and now Assistant in the Agricultural Engineering Department, Allahabad Agricultural Institute, got married in Assam on April 30th, 1941.

Mr. N. S. Pandalay, B. Sc. (Ag.), of the class of 1939, got married in Travancore on November 11th, 1940.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES

For June, 1941

I—Season.—Rainfall during the month was general and fairly distributed. It was heavier in the first fortnight as compared with the second. With the exception of Gorakhpur and Fyzabad Divisions, and certain Western Districts it was poor in the major part of the Province.

II—Agricultural Operations.—Agricultural operations are in progress. Irrigation of sugarcane and paddy continued in canal irrigated areas. Rains are badly needed in a large number of districts. Preparation of land for Kharif crops continued where there was sufficient rain.

III—Standing Crops and Prospects of the Harvest.—The condition of standing crops is so far fair and prospects are favourable but much depends on early rains.

V—Damage to Crops.—No serious damage to crops is reported from any district.

VI—Agricultural Stock.—Cattle disease is reported almost from every district. The Hæmorrhægic Septicæmia has increased to a great extent while rinderpest and foot and mouth disease showed considerable decline as will be seen from the following figures:

Disease	May, 1941		June, 1941	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	2,735	1,302	1,667	938
Foot and mouth	12,238	62	6,427	41
Hæmorrhægic Septicæmia	145	111	580	496

VII—Pasturage and Fodder.—Fodder and water are reported to be sufficient everywhere.

VIII—Trade and Prices.—Prices of foodgrains such as wheat, barley, gram, rice and arhar dal have risen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

	End of May, 1941	End of June, 1941
Wheat	3·592	3·941
Barley	2·217	2·779
Gram	2·725	3·145
Rice	5·494	5·910
Arhar dal	3·669	3·938

IX—Health and Labour in Rural Areas.—The condition of agricultural and labouring population is generally satisfactory. Cases of Cholera are reported from most of the districts. Some cases of small-pox are reported from certain districts

FOR JULY, 1941

I—Season.—During the month under report scattered showers of rain were received throughout the province. In all districts the rainfall was below the normal.

II—Agricultural Operations.—Agricultural operations are in progress Irrigation of sugarcane and paddy and preparation of land for the *rabi* season and late *kharif* crops are in progress. Transplantation of paddy wherever moisture conditions permit continues.

III—Standing Crops and IV—Prospects of the Harvest.—The condition of standing crops is not generally promising. The prospects are not quite favourable.

V—Damage to Crops.—Damage from drought to the standing *kharif* crops is reported from many districts.

VI—Agricultural Stock.—Cattle disease is reported from a large number of districts. Haemorrhaegic Septicaemia, rinderpest, and foot and mouth diseases have increased to some extent as will be seen from the following figures furnished by the Director of Veterinary Services, United Provinces :

Disease	June, 1941		July, 1941	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	1,667	938	1,908	985
Foot and mouth	6,427	41	6,988	43
Hæmorrhægic Septicæmia . ..	580	496	1,130	964

VII—Pasturage and Fodder.—Fodder and pasturage are reported to be insufficient from a large number of districts.

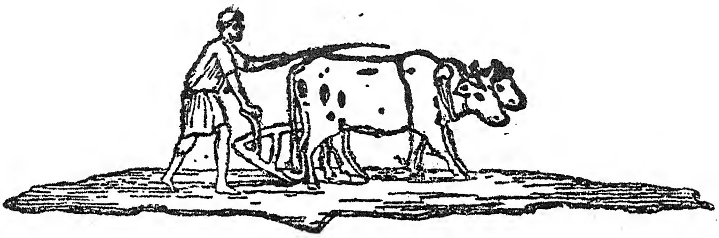
VIII—Trade and Prices.—The prices of the chief food grains, such as wheat, barley, gram, rice and arhar dal have risen to some extent. The following figures compare the retail prices, in rupees, per maund at the end of the month with those of the preceding month.

	End of June, 1941	End of July, 1941
Wheat	3·941	4·275
Barley	2·779	2·826
Gram	3·145	3·472
Rice	5·910	6·201
Arhar dal	3·938	4·347

IX—Health and Labour in Rural Areas.—The condition of agricultural labour is on the whole satisfactory. Cases of cholera and small-pox are reported from certain districts.

THE

ALLAHABAD FARMER



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Editorials

The Marketing of Groundnuts in India.

Groundnut (Arachis hypogea) sometimes known as peanut is not indigenous to India, but has been introduced into Asia and Africa probably from Brazil, the probable home of its origin, in the sixteenth century. The demand for groundnut and groundnut oil in the world market has increased steadily that in the 1933-37 quinquennial the average area under groundnut is 19 million acres, of which 7 million acres is found in this country. The acreage in this country is still in the increase so that the area in 1938 had gone up to 8·5 million acres, a tremendous increase, especially when we know that the groundnut acreage in India before 1914 was only just over 2 million acres. But this increase in the acreage is not confined only to this country. There is a similar increase in acreage in other countries of the world, such as China, Senegal and in the United States of America, although the groundnut acreage in this country is by far the largest when compared with that in other countries of the world. India

possesses 36 per cent of the total groundnut acreage of the world. And although several factors seem to favour China as the area in which phenomenal increase in the production of groundnuts is possible, this country also has several advantages over other countries in the production of groundnut. The advantageous position which China has over other countries in the production of groundnut is reflected in the average yield of 1600 lbs. per acre in that country, whereas the average yield in this country is 900 lbs, the average yields in French West Africa and the United States of America being still less—800lbs. per acre. However the character of the groundnut crop as well as the demand for vegetable oil will further contribute to the rapid expansion of acreage in India.

India today because of its very large acreage in groundnut is by far the largest exporter of groundnuts. She exported 1189 thousand tons of decorticated groundnut in 1938, whereas the whole continent of Africa exported 761 thousand tons of both decorticated and undecorticated nuts, and China only 57 thousand tons only. A great deal of the nuts is exported to France, Germany, Italy, the Uuited Kingdom and the Netherlands; although, as a result of this war, the export of groundnuts to European countries has almost disappeared.

The main groundnut producing areas in India are the Madras Presidency (3,820,000 acres), Bombay (2,384,000 acres), Hyderabad State (1,686,000 acres), Central Provinces and Berar (226,000 acres), Mysore (221,000 acres), United Provinces (159,000 acres) and Orissa (20,000 acres).

The groundnuts grown in this country are of two distinct types, the trailing and erect types. The trailing type consists of two varieties, Coromandel and Bold, and the erect or bunch type consists of Red Natal and what is generally known as "Peanuts."

The Bold variety possesses very large kernels but is not so rich in oil content as the other varieties. The Coromandel has also fairly large kernels but is not so rich in oil content as the "peanut" varieties, although it is similar to Red Natal

in its oil content. The "peanut" variety also known as the Spanish peanuts seem to be the richest in oil although the kernels are fairly small.

India exports a great deal of groundnuts in the form of kernels, the average being about 774,000 tons valued at 11 crores of rupees during the quinquennium ending in 1938. This is equivalent to 1,112,000 tons nuts in shells or 39 per cent of the total production. But although this country is now the biggest producer of groundnut oil in the world, her share in the export of groundnut oil is very small, being altogether about 9000 tons only. The exports of groundnut cake are of greater magnitude being on the average about 219,000 tons.

In their report on the marketing of groundnut in India and Burma the Agricultural Marketing authorities of the Government of India draw the attention of the country to the fact that while the average yield of groundnut in India is about 900 lbs. per acre, the yields at Government Farms in India have, in some instances, been as high as 1,700 lbs. per acre of an unirrigated crop and over 3000 lbs. per acre of an irrigated crop. There is therefore much room for improvement in the yield of groundnut in the cultivators' fields. The report also points out that there is a great deal of variation in the proportion of kernels and shells in nuts. This kernel percentage seems to be dependent not only on the variety but also on soil and climatic factors. This aspect of the problem therefore deserves more study and attention in the various research stations in groundnut areas in this country.

The report makes among others the following recommendations:—

(1) Harvesting the crop when fully mature and drying the pods before sale, (2) more care in the decorticating of groundnuts in factories, (3) the reduction of impurities, including castor seed, (4) the prevention of the development of fatty acids in the nuts; and several other recommendations which, if followed, will, we are sure, help greatly the development of the groundnut industry in this country.

SYNTHETIC FARMYARD MANURE AND COMPOSTS

২৫ *By*

S. CHOWDHURY, B. SC. AGRI., ASSOC. I.A.R.I.

The term 'synthetic' or 'artificial' farmyard manure was first used by Hutchinson and Richards to indicate a substance obtained from straw, resembling very closely the ordinary farmyard manure, by artificial treatment of the straw. In 1921, the results of experiments, carried out by Hutchinson and Richards at Rothamsted on the conversion of straw into manure without the intervention of livestock, were published. In this pioneering work, which constitutes an important milestone in the development of crop production, a method was devised by which straw could be converted into a substance having many of the properties of stable manure. In the preliminary experiments, the most promising results were obtained when the straw was subjected to the action of a culture of an aerobic cellulose decomposing organism (*Spirochaeta cytophaga*) whose activities were found to depend on the mineral substances present in the culture fluid. The essential factors in the production of well-rotted farmyard manure from straw were found to be: air supply, a suitable temperature, and a small amount of soluble combined nitrogen. The fermentation was aerobic; the breakdown of the straw was most rapid in a neutral or slightly alkaline medium in the presence of sufficient available nitrogen. Urine, urea, ammonium carbonate and peptone (within certain concentrations) were all useful forms of combined nitrogen. Sulphate of ammonia by itself was not suitable, as the medium soon became markedly acid. The concentration of the combined nitrogen added was found to be important. When this was in excess, nitrogen was lost from the mass before decay could proceed; when it was in defect, a marked tendency to fix nitrogen was observed. The publication of this paper soon led to a number of further investigations, and to numberless attempts all over

the world to prepare artificial farmyard manure from every kind of vegetable waste.

Principles Underlying the Conversion of Vegetable Wastes into Farmyard Manure :

The principles underlying the conversion of vegetable wastes into artificial or synthetic farmyard manure are now well understood and have recently been summed up by Waksman and his co-workers. The principles underlying the conversion are so well put by these investigators that they are best given in the author's own words :

"The problems involved in the study of the principles underlying the decomposition of mature straw and other plant residues in composts, leading to the formation of the so-called artificial manure, involve a knowledge of : (*a*) the composition of the plant material ; (*b*) the mechanism of the decomposition processes which are brought about by the micro-organisms ; and (*c*) a knowledge of the metabolism of these organisms.

"Straw and other farm residues, which are commonly used for the purpose of composting, consist predominantly (60 per cent or more) of celluloses and hemi-celluloses, which undergo rapid decomposition in the presence of sufficient nitrogen and other minerals, of lignins (15 to 20 per cent) which are more resistant to decomposition and which gradually accumulate, of water-soluble substances (5 to 12 per cent) which decompose very rapidly, of proteins which are usually present in very small amounts (1,2 to 3 per cent) but which gradually increase in concentration with the advance of decomposition, and of the mineral portion or ash.

"The processes of decomposition involved in the composting consist largely in the disappearance of the celluloses and hemi-celluloses, which make up more than 80 per cent of the organic matter which is undergoing decomposition in the process of formation of artificial manures. These polysaccharides cannot be used as direct sources of energy by nitrogen fixing bacteria and their decomposition depends entirely upon the action of various fungi and aerobic bacteria.

In the process of decomposition of the cellulloses and hemi-celluloses, the micro-organisms bring about the synthesis of microbial cell substance. This may be quite considerable, frequently equivalent to a fifth or even more of the actual organic matter decomposed. To synthesize these large quantities of organic matter, the micro-organisms require large quantities of available nitrogen and phosphorus and a favourable reaction The nitrogen and phosporus are used for the building up of the proteins and nucleins in the microbial cells. Since there is a direct relation between the celluloses decomposed and the organic matter synthesized, it should be expected also that there would be a direct relation between the cellulose decomposed and the amount of nitrogen required. As a matter of fact, for every forty or fifty parts of cellulose and hemi cellulose decomposed, one unit of available nitrogen has to be added to the compost

"As the plant residues used in the preparation of 'artificial manure' are poor in nitrogen, available in organic nitrogen must be introduced for the purpose of bringing about active decomposition. This explains the increase in the protein content of the compost accompanying the gradual decrease of the cellulose and hemi celluloses

" In general, artificial composts can be prepared from plant residues of any chemical composition so long as the nature of these residues and of the processes involved in their decomposition are known. By regulating the temperature and moisture content and by introducing the required amounts of nitrogen, phosphorus and potassium and calcium carbonate, the speed of the decomposition and the nature of the product formed can be controlled.

System of Making Compost :

There are three main systems of making compost *viz.*, the Indore, Fowler and ADCO. The first simplified, as it is at the present day, and adjusted in its technique either to large farm conditions where water may be present permitting ready processing or to village conditions where water may be only freshly available in the rains offers no serious difficulties

and when once appreciated is easy to carry out. It is rather slower in its results than the Fowler system and thus better suited to cultivator, conditions where manure is required at intervals rather than as a steady stream. Fowler's method is essentially at its best in dealing with town waste where it is essential that the waste be cleared as rapidly as possible. The ADCO process or its modification, *i.e.*, the direct incorporation of the materials with artificials is of value where tillage is largely mechanical and cattle to supply the necessary dung and urine called for by the other methods may be a limiting factor.

The manufacture of compost by the Indore method will be described here in some detail

Manufacture of Compost by the Indore Method:

"The first requirement of the process is an area of land, conveniently situated for supervision. At Indore this consists of 33 pits, each 30ft. by 14ft. and 2ft. deep with sloping sides, arranged for the easy passage of loaded carts. The pits are in pairs, with a space 12 ft. wide between each pair. Water is provided by a tank, holding 3,200 gallons, 4ft. above the ground to provide the necessary head. The water is led by 1·5 in pipes from the tank to eight taps, to which the armoured hose (fitted with a suitable nozzle) can be screwed. Each tap serves six pits.

Waste Products: The materials needed for making humus are the following:

(1) *Mixed Plant Residues:*—All vegetable wastes from the estate such as weeds, green manure, cane trash, fallen leaves, light prunings, water hyacinth, trimmings from roadsides and hedges, straw, chaff, wood shavings, sawdust, waste paper, old gunny bags and so forth ..are collected and stacked. All hard woody materials are either crushed (by being placed on the estate roads and broken up by the traffic) or cut into short lengths by a chaff-cutter. All fresh green materials...such as weeds, green manure and water hyacinth... must be withered before stacking. To ensure even mixture, the stacked material is removed from one end of the stack either to the pits direct or as bedding for the work cattle.

(2) *Cattle, Buffalo and Horse Dung* (including all soiled bedding from under the animals).

(3) *Urine Earth* :—The earth under the animals should be dug out to a depth of six inches every three months, powdered in a mortar mill and stored under cover near the compost pits. Fresh earth is then added to replace the urine earth which has been removed.

(4) *Wood Ashes* :—These are useful for neutralising acidity and for increasing the potash content of the final product.

(5) *Water and Air* :—These are essential for the fungi and bacteria which manufacture humus.

Charging the Pits :

The pits are charged as follows : A broad plank is first laid across the pits so that they can be filled without consolidating the material by trampling. A layer about 3 inches deep of mixed plants residues is first spread by a rake lightly and evenly over the floor of the pit. This is well sprinkled with a mixture of wood ashes (if available) and urine earth. A layer about two inches deep of broken dung and soiled bedding follows. The contents are then well moistened (not flooded) with the hose. The charging and watering processes are continued till the pit is filled to a depth of 30 inches in all, finishing off with a layer of dung and soiled bedding followed by a good sprinkling of urine earth, ashes and water. The pit is watered in the evening and again the next morning. By giving the first watering in three stages, time is given to the mixture to absorb sufficient moisture to start the intense fermentation which soon sets in. Rapid sprinkling then takes place and the contents of the pit contract to the ground level.

Watering :

The subsequent waterings are most important. The pits should be watered once a week and at the time of the first, second and third turns.

Turning :

To ensure uniform mixture and decay to provide the air and water needed by the organisms the material is turned three times. *First turn* : This is done when the pit is 10 to 14 days old. Half the pit is dug out with the fork, the contents are moistened and doubled lengthwise over the undisturbed half. The half turned heap is then well watered. *Second turn* : Fourteen days after the first turn, the material is again turned, watered and piled up loosely along the empty half of the pit. *Third turn* : When the pits are two months old, the dark crumbling material is moistened and stacked on the surface in rectangular heaps...10ft. broad at the base, 9 ft. wide at the top and 3·5 ft. high to ripen for a month, when it is ready for the fields. During the ripening period, a good deal of extra nitrogen is obtained by fixation from the atmosphere. When the humus is carefully made, the total gain of nitrogen may be as much as 25 per cent.

Humus Manufacture During the Rains :

During the rains when the pits are often full of water humus must be made in heaps on the surface. Where the rainfall is moderate, the heaps should be 8 ft. by 8ft. at the bottom and 7ft. by 7ft. at the top and 2ft. in height. Where the monsoon is very heavy composting should be carried out under cover, or if this is impossible, the manufacture may have to be suspended during the period of very high rainfall.

Testing the Efficiency of the Process :

The efficiency of the process can be tested by observation and without recourse to chemical or biological analysis. During the first month fungi are engaged in breaking down the mixed wastes. The heaps should be a mass of white fungoid growth and the temperature should be high. If a metal rod be inserted at this stage, it should be hot to the touch when withdrawn. After the third week the mass darkens in colour and becomes crumbly. Bacteria from now onwards take an increasing share in the process.

If at any time the fermentation stops and the pits cool, want of moisture is the most likely cause. Should the heaps begin to smell, flies will be at once attracted and will proceed to lay eggs followed by the development of maggots in large numbers. This only happens when there is some interference with the air supply. The remedy is to turn the heap at once and to add dung and ashes. The chief causes of insufficient aeration are excessive trampling, the addition of too much urine earth and ashes, over-watering or failure to turn the mass at the proper times.

Character of the Finished Product:

The ripe compost consists of a brownish-black finely divided powder, of which about 80 per cent will pass through a sieve of six meshes to the linear inch. The state of division of an organic manure is an important factor, second only to its chemical composition. This property enables the Indore compost to be rapidly and easily incorporated, and to exert its maximum effect on the internal surface of the soil. The carbon nitrogen ratio is not far from the ideal figure of 10: 1. The nitrogen is therefore in a stable form, which does not permit of liberation beyond the absorption capacity of the crop. The composition naturally varies to some extent with the locality and the materials used. Humus manufactured according to the Indore method has been found to contain on an average about 1 percent of nitrogen, about 0·5 per cent of phosphoric acid and about 3 per cent of potash. On the tea estates in Travancore, where compost is being made on the large scale under Dr. C. R. Harler's supervision at an average cost of about Re. 1-8 per ton, the nitrogen content is as high as 1·3 per cent., the phosphoric acid and potash figures being very like those obtained at Indore.

Manurial Value of Indore Compost:

One cart-load of Indore compost is equivalent, as regards nitrogen content, to two cart-loads of ordinary farmyard manure Properly made compost has another great advantage over ordinary manure, namely its fine powdery character which enables it to be uniformly incorporated with the soil and to be

rapidly converted into food materials for the crop. Taking everything into consideration Indore compost has about three times the value of the ordinary manure.

Output of Compost by Indore Method:

Fifty cart-loads of ripe compost per pair of oxen per annum can be made from the plant residues available on any holding. The quantity can be more than doubled when all the dung and urine earth are used, provided of course sufficient vegetable refuse can be secured.

ADCO Vs. Indore Method:

In all the comparative trials which have been made at Indore with ADCO on the one hand and with urine earth and cowdung on the other hand, far more satisfactory results have been obtained with the indigenous materials. The weak point of ADCO is that it does nothing to overcome one of the great difficulties in composting, namely the absorption of moisture in the early stage. In the hot weather in India, the ADCO pits lose moisture so rapidly that the fermentation stops, the temperature becomes uneven and then falls. When however urine earth and cowdung are used the residues become covered with a thin colloidal film, which not only retains moisture but contains combined nitrogen and minerals required by the fungi. This film enables the moisture to penetrate the mass and helps the fungi to establish themselves. Another disadvantage of ADCO is that when this material is used according to the directions, the carbon nitrogen ratio of the final product is narrower than the ideal 10 : 1.

Material Available for Composting:

A large number of vegetable wastes are available for making composts : cotton stalks, sunn-hemp, either as green plants reaped before the flowering stage or as dried stems of the crop kept for seed, pigeon-pea stalks, sugarcane trash, weeds, fallen leaves, mixed dried grass, gram stalks, wheat straw, uneaten and decayed silage, millet stalks, residues of

the safflower crop, groundnut husks, groundnut stalks and leaves, sugarcane and millet stumps, waste paper and packing materials, shavings, saw-dust, worn-out gunny bags, old canvas, wornout uniforms, old leather belting, prickly pear, water-hyacinth. Experiments made in composts manufacturing with all these wastes have been found to give satisfactory results. The ideal chemical composition of the materials to be used for composting should be such that, after the bedding stage, the carbon-nitrogen ratio is in the neighbourhood of 33 : 1. The material should also be in such a physical condition that the fungi and bacteria can obtain ready access to and break down the tissues without delay.

The chemical composition of some of the materials that can be used profitably and satisfactorily for composting is given in the following table.

Chemical Composition of Raw Materials

Material.	Organic Matter.	Ash.	Proteins	Fats.	Fibre.	Soluble Carbohydrates.	Nitrogen.
Malvi cotton stalks (with leaves and pericarps) ..	90·17	9·83	7·35	3 2	36 09	43·53	1 176
Cambodia cotton stalks ..	96·91	3·09	4·00	1·11	45·31	46·49	0·64
Cambodia cotton leaves ..	87 45	12·55	14·06	8·49	8·71	56·19	2·25
Mixed weeds ..	69·48	30·52	10·83	2·05	21·92	34·64	1·74
Sann hemp 12-wks. old stem ..	96 30	3·70	4·00	1·06	53·61	37·6	0·64
Sann hemp 12-wks old leaves ..	90·64	9·36	14·26	2·90	20·70	52·80	2·29
Arhar stalks ..	91·08	8·92	4·37	1·90	39·64	45·17	0·70
Sugarcane trash	94·09	5·91	2·00	1 25	42·16	45·73	0·32
Water-hyacinth ..	75·80	24·20	9·37	..		..	2.17

CHEMICAL COMPOSITION OF RAW MATERIALS. *(Contd.)*

Material.	Organic Matter.	Ash.	Proteins.	Fats.	Fibre.	Soluble Carbohydates.	Nitrogen.
Ficus indica ..	82·08	17·92	2·18	1·12	28·37	50 39	0·35
Millet stalks ..	89·90	10·10	2·24	..	25·42	61·57	0·70
Rice straw ..	80·90	19·10	2·25	1·05	35·10	40·40	0·36
Wheat straw .	84·70	15·30	3·01	0·98	35 69	37·93	0·58
Gram residues ..	85·70	14·30	4·68	2·27	26·71	45·86	0·75
Groundnut residues ..	86·60	13·40	12 06	2 20	16·60	39·42	1·93
Groundnut Husks	85·80	14·20	7 57	2·80	55·35	13·73	1·21
Banana stem ..	84·20	15·80		..	..	..	0·016

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METHODS OF MAKING JELLIES FROM DIFFERENT FRUITS

By

A. DAYAL CHAND, M.A., B. SC. (AG.), F.R.H.S.

(Continued from previous issues of the Allahabad Farmer.)

13. ORANGE JELLY.

Orange jelly strictly speaking is never pure orange jelly, because the sweet orange as well as the sour orange is weak in pectin content and the former is even lacking in acid. So unless pectin is added in both, and acid to sweet orange juice, they do not make good jelly. The most common method of making up the deficiency of acid and pectin, is to mix a few lemons with the orange pulp.

Process.—Take three parts of oranges and one part of lemons. Cut them into slices and add three pounds of water to each pound of fruit. Cook this mixture for about half an hour or until the fruit slices become absolutely soft. Remove the kettle from the fire and strain the juice through a thick jelly-bag without pressing.

Take three pounds of juice, boil it for about five minutes and add the same amount of sugar. Continue cooking until the jelly stage is reached. Remove the kettle from the fire and pour boiling hot jelly into the sterilized hot containers. When the jelly has set firmly, seal the containers with boiling hot paraffin.

14. GRAPEFRUIT JELLY.

Grapefruit at present is a very expensive fruit and it may be considered uneconomical to make jelly from it. But from the growers' point of view it is economical because wind-fallen and partially blemished fruits which cannot find

a market, can be used for making jelly. The time is not very far distant when this fruit will also be grown extensively in India and will become cheap.

Grapefruit is rich in pectin, but does not contain enough acid, therefore, good jelly cannot be made from it without adding acid. In order to raise the acid content to the required concentration, either use one part of lemons with four parts of grapefruit or add 3 c.c. of 0·577 citric acid for each pound of grapefruit juice.

Process.—Take the grapefruit and lemons in the above proportion, weigh, wash and cut them into slices. Add three times as much water as fruit and cook them for about half an hour until the rind becomes soft. Strain the juice without pressing.

Take equal proportions of juice and sugar, and cook rapidly, skimming off the scum occasionally. Continue boiling until the juice "sheets off" from the spoon.

It usually jells at 218 or 220 F. Remove it from the fire and put it into sterilized jars and seal.

15. Pummelo Jelly

The chemical composition of pummelo is somewhat similar to that of grapefruit and therefore pummelo jelly can be made by following the same instructions as for grapefruit.

16. Lemon Jelly.

Lemons are very rich in both acid and pectin and therefore they make excellent jelly. Many Europeans are fond of lemon jelly due to it slight bitterness which is introduced by its rind. Indian people generally do not like bitter jelly, so in order to make sweet jelly, the lemon rind may be separated from the fruit and boiled separately for a few minutes. The juice is thrown away which carries all the bitterness with it. The rind is then cooked with the pulp which produces sweet jelly.

Process.—Select sound, unblemished lemons, weigh and wash them thoroughly to remove the dirt. If bitter jelly is

required, cut the fruits into thin slices and cook rind and pulp together for the extraction of juice. But if sweet jelly is preferred, peel off the rind, boil it and throw away the water. Pour the pulp in the cooked rind and add four pounds of water to each pound of fruit. Cook it for about half an hour until the fruit becomes soft and strain the juice without pressing.

Take three pounds of juice, bring it to boil and add the same amount of sugar. Continue cooking rapidly until the jelling point is reached, which in this case is between 118 to 119 F. Pour the jelly into sterilized containers and when it has finally set, seal with melted paraffin.

It has been found that when jelly from whole lemons is made it produces a slightly bitter taste, but it has much better flavour and retains it for a longer period than jelly made from the peeled fruits.

17. Khatta or Karna Jelly.

Khatta is similar in acid and pectin content to the lemon, and therefore one may follow the same direction for making khatta jelly as for lemon.

18. Kumquat or Hazara-Orange Jelly.

The Indian kumquat, *Citrus microcarpa,* is commonly known as Hazara or China Orange. It is not grown from the commercial point of view, but is grown as an ornamental plant around the bungalows. Little or no economic use is made of this fruit except that the branches of kumquat laden with small golden yellow fruits are cut and used for decoration. The fruit is very tart and is rich in pectin. It is therefore used for making preserves and jelly. Kumquats should not be used for making jelly when green or have turned soft. For obtaining the best flavour and colour the fruits should be used when they are firm, but yellow in colour.

Process:—Pull off the kumquats from the plants at their firm stage. Weigh and wash off the adhering dirt.

Cut them into halves and cook them in three times as much water for about twenty minutes. Strain the juice through a jelly bag.

Take a desirable amount of juice, bring it to a boil and add equal parts of sugar. Dissolve the sugar by stirring and cook rapidly to the jelling point, removing the scum as it appears. Pour the boiling hot jelly in sterilized jars and seal.

19. Apple Jelly.

The apple is a universal fruit, being widely cultivated in almost all countries. Many varieties have been evolved due to its extensive cultivation. From the point of view of jelly making, apples can be classed as white-skinned and red-skinned. The red skinned apples give a brighter and more attractive jelly than the white-skinned.

Almost all varieties of apples are reliable in pectin content, but they vary a good deal in acid content. Sour varieties of apples and crab apples are rich in both acid and pectin and are extensively used for the purpose of manufacturing jelly as well as pectin. Sweet apples being low in acid are not suitable for this purpose unless either sour varieties of apples are blended with them or a little acid is added to their juice. Because apple juice is rich in pectin and possesses a distinct flavour, it lends itself to various combinations and forms an ideal base for making mixed jellies. Desirable combinations in which apple juice supplies the necessary additional pectin are, apple and pineapple, apple and grape, apple and quince, apple and peach, apple and tomatoes, etc.

Process :—Select unblemished apples of sour varieties. Wash the unpeeled apples and cut them into slices. Add $1\frac{1}{2}$ to 2 pounds of water to each pound of sour apples, but equal amounts to sweet varieties. Cook the fruit in a covered kettle for about half an hour until the fruit becomes tender. Strain the juice through a thick cloth bag and make a pectin test.

Take a desirable amount of juice, boil it for five minutes and if sour varieties of apples are used add an equal amount

of sugar, but if a sweet variety is used, add three-fourths of a pound of sugar to each pound of juice. Boil rapidly over a strong fire, removing the scum when necessary. Test the jelling point and cook it a few minutes longer in order to make stiff jelly. Remove it from the fire, pour it into sterilized containers and when it sets, seal the jars with melted paraffin.

20. Crab-Apple Jelly.

Crab-apples are quite rich in both acid and pectin. They should be treated in the same way as the sour varieties of ordinary apples. Crab-apples make a very clear and firm jelly which is very much relished.

21. Apple and Pineapple Jelly.

The pineapple lacks pectin, but some varieties are low and the others are rich in acid. It has a mild flavour which makes it suitable for making mixed jelly along with other fruits. Apples and pineapple mixed together make an excellent jelly. Wherever pineapples are not cheaply available, the canned pineapples or pineapple juice may economically be used.

Process:—Cut off the leaves and leafy end of the pineapples and core them from both stem and blossom ends. Weigh them and add to them an equal quantity of tart apples. Cut them in pieces and cook them in twice the amount of water, until the fruit slices are rendered soft. Strain the juice and follow the same instructions for making jelly as described for apples.

"There's only one explanation when two people don't get along. Getting what they want seems more important than getting along."

REVIEW OF THE FRUIT SERIES BULLETIN No. 23, OF THE UNITED PROVINCES DEPARTMENT OF AGRICULTURE, ON GRAPE VINE CULTIVATION.

By

K. B. Mathur, B. Sc. (Ag.)

India produces 3,75,250 maunds of grapes but consumes 6,47,250 maunds of fresh and 225,000 maunds of dried fruit annually. She imports all of the raisins or currants and also half of the fresh fruit consumed every year. Most of her crop is produced in the districts of Baluchistan, Poona and Nasik, though it is extensively cultivated in the districts of Sindh, Kashmir and Peshawar also. Other parts of the country too would have taken up this industry, had it not been for the exacting climatic requirements of the crop. Specially in the United Provinces it could not be successfully introduced because of the rains which set in about the time the fruit is ripening. At this stage bright sunshine and dry weather are essential Heavy rains would damage most of the crop. Nevertheless there may be some varieties which would ripen before the advent of the monsoon or very nearly so Indeed continuous cultivation of this crop for more than 3000 years in different parts of the world offers a large number of varieties from which some promising ones may be discovered. The discovery of suitable varieties or the evolution of pruning, fertilizer and irrigation practices which will force the vines to suit our needs, calls for determined and persistent experimentation on the part of the provincial department.

We feel specially interested in this industry as it would prove profitable not only to the growers near cities but also to the ones in remote villages. They could dry the crop and sell it in the city market at their convenience. Trebling the present production would just meet our annual demand and an increased acreage under grapes cannot be calculated

to lead us into the dangers of over production or unhealthy competition. Considered from the government point of view, expansion of this industry would be remunerative. Hence the Fruit Series Bulletin No. 23 of the Department of Agriculture, United Provinces, on Grape Vine Cultivation is welcome.

In this bulletin, a number of varieties available at Saharanpur, Allahabad and Agra are enumerated. Their description is not given but those considered "worth growing either in the plains or on the hills where there is minimum rainfall" according to "the latest reports of viticulture from Calcutta" are briefly described. The amount of rainfall considered minimum is not mentioned but probably districts where rainfall is low are meant. Definite recommendations as to the different varieties suitable to different parts of the province are omitted. A mere rosary of meaningless names of varieties is a poor guide to the grower. Different methods of propagation are described with suitable sketches and at places the advantage of one method over the other is hinted at, *e.g.* "In fact that this method of propagation (layering) is used in the cases of those vines which are difficult of propagation by cuttings." Concrete examples of such vines might have been more definite. Some space is usefully allotted to top working which is used to rejuvenate old vineyards or for grafting superior varieties on the previous ones. The description is too brief, *e.g.* that of cleft-grafting on page 6 of the bulletin. If the space was limited a reference to the previous literature where it is described better could have been made. It is doubtful whether planting on a well-manured level field is not as good as by the pit or trench system. If the latter systems are not significantly advantageous, the expenses incurred in the preparation of pits or trenches are not advisable. The pruning and training of the plant is adequately described but it is interesting to note that no reference is made to the green support of pangara trees (Erithrina indica) considered indispensible in the Deccan. The diseases should have been more elaborately described so as to give a vivid picture of the trouble.

For the treatment of Powdery Mildew the bulletin states, "A hot water method is also recommended." The natural

question is " which?" and it remains unanswered. Another method of controlling this disease in which flowers of sulphur are heated in a large pan seems to be tedious and more expensive than simple dusting. Terms like " fibrous loam " and " the more alluvial the soil " used to indicate best soils for grape vine cultivation are ambiguous. Besides, several mistakes probably due to careless proof-reading occur in the text. These make reading unpleasant. Some of these mistakes are given below :

1. "Description" "for introduction" on the first line from the top on page 1.

2. "Vitis Vinifera" for "Vitis vinifera" in the first line from the top page 1.

3. "is" for "are" on the first page 13th line from the top.

4. "vine" for "wine" on page 12 line 11 from the top

5. "contained in" for "continued in" on page 13 first line from top.

6. "States" for "states" on page 16 line 14 from the top.

7. "emerged in" for "immersed in" on page 16 first line from the top.

8. "to that" for "so that" on page 17 line 12 from the bottom.

On the whole the bulletin surveys briefly the different phases of the vine industry. Useless sentences are avoided and necessary sketches are placed close to the relevant text. In his attempt to be brief the author has at places sacrificed clarity for brevity. Recommendations for this province are entirely wanting. The bulletin thus seems to be of greater value to a student preparing for an examination than to the practical grower for whom the series is intended.

The true workers redeem inch by inch the wilderness into garden ground: by the help of their joined hands the order of all things is surely sustained and vitally expanded.

JOHN RUSKIN.

HISTORY OF CATTLE IMPROVEMENT IN THE ESTATE OF SIR DANIEL HAMILTON, GOSABA, SUNDERBANS.

BY

HARIDAS CHAKRAVARTY, B.SC. (AGR.)

Agricultural Lecturer, Gosaba.

Of all the domestic animals, cattle are comparatively the most important in India. In India cattle are valued for milk and draft purposes. The livestock industry of India, although in a disorganised state at the present moment, can be converted into a valuable asset for the country, when developed on organised and scientific lines. In all provinces, cattle breeding is now receiving attention and cattle farms have been provided. If we take into account the fact that India has more than five million bulls, it will be apparent how small is the direct influence which Government cattle breeding farms can exercise on the cattle of the country. The development of cattle breeding means the betterment of Indian agriculture and its allied branches such as dairying, etc The development of the dairy industry should be seriously taken in hand and as soon as possible.

For many years Sir Daniel Hamilton tried to improve various crops of Gosaba. But afterwards he found that in order to make agriculture more successful the existing cattle of Gosaba should also be improved. With this end in view Sir Daniel Hamilton during the years 1916—1918 purchased from different places of India one Nellore bull, one Ayrshire bull, six Montgomery cows with calves, and three Montgomery bulls, for the improvement of cattle at Gosaba.

The Ayrshire bull, which was purchased from the Imperial Agricultural Research Institute, Pusa, served here for three years, and then died of rinderpest.

The Nellore served here for about eight years and good results were obtained from the grades. The Montgomery

was also tried at the same time for grading the existing village cows which were mostly scrubs. The maximum yield of milk of the Montgomery cows reached up to 20 lbs., and the grades were found invariably better than Nellore grades as regards milk production. In the meantime the Nellore bull died of old age, and further improvement with this particular breed came to an end.

Within two years the Montgomery herd reached up to 27 head of cattle including calves of both sexes. Sir Daniel Hamilton distributed cows, heifers and bull calves to the local tenants with the idea that they would realise the utility of keeping a good breed instead of a large number of scrubs. Further it was his idea to teach the illiterate tenants to learn whether they are keeping the cows or the cows are keeping them. The most interesting point to note was that Sir Daniel Hamilton sold those cows to the local tenants at a nominal price of Rs. 20 each instead of Rs. 200 each which he had to pay at the time of purchasing them.

From this, one can easily understand how far Sir Daniel Hamilton realised the importance of the improvement of cattle in his estate. But it is very painful to mention here that the energy of Sir Daniel Hamilton in this particular line of work was simply wasted by the illiterate tenants on account of their ignorance. Not understanding the value of those Montgomery cows they sold them to outsiders at a higher price.

Feeding and care of the cows are the most important points which one should realise before keeping cows for milk production. The Montgomery cows supplied by Sir Daniel Hamilton to the tenants were underfed. The maintenance ration, which is the most important point in the feeding of cattle, was totally overlooked by the tenants. They also never thought of the necessity of giving the cows the ration for milk production, which is the second important point to be kept in mind by every cow keeper.

However some improvement was made in the cattle of Gosaba by grading the scrubs with the Montgomery bulls which were brought for breeding purposes during the years 1916-18.

At that time the late Babu Rajeshwar Das Gupta, the one time Deputy Director of Agriculture of the Agricultural Department, Bengal, supplied about 20 good country cows, the average yield of milk of which was about 7 lbs. In the same year Messrs. Cook and Cook supplied about a dozen cross-bred cows of different breeds. The cows supplied by Messrs. Cook and Cook gave good results here, and the average yield of milk of most of the cows reached up to 12 lbs. Those cows lived for a long time but gradually died of old age. The progeny of those cows which are still living can be considered to be the grades of Montgomery.

Again in the year 1921, about half a dozen Montgomery bulls were purchased for further improvement. At that time the bulls were stationed in six centres of the estate. This method was adopted with the idea that the tenants could get the bulls easily. Those bulls were used for breeding purposes for more than eight years and afterwards died on account of old age. Thus up to the year 1928 the attempts at cattle improvement at Gosaba were carried on mostly with the Montgomery bulls.

Sir Daniel Hamilton spent a large amount of money for grading the cattle of Gosaba with Montgomery bulls. It seems from the above facts that he simply wanted to improve the milk production of the cows. He should not however have given so much stress on the improvement of the milk yield only, as Indian agriculture is also connected with the bullock. The Montgomery breed is considered to be very poor for draft purposes. And as the tenants of Gosaba solely depend on their lands, it is very easy to understand the fate of the bull calves of the Montgomery breed which could not be used efficiently by the cultivators for cultivation. It was impossible for the tenants here to maintain two breeds of cattle, one for milk and another for draft. Further it was also very important to teach the cultivators the growing of fodder crops. The cultivators, for want of fodder crops in the winter months, could not feed the cattle properly. The only available fodder here is paddy straw which is considered to be inferior to wheat and barley straw. Until the cows can be fed with green fodder in the winter

months it becomes a difficult problem to keep them in good condition. It has been found by experiments in the Rural Reconstruction Institute farm that Napier grass grown in the high lands yields sufficient fodder for the cattle. But it becomes very difficult to take cuttings in the winter months from the Napier grass when the rainfall is scanty and the only source of irrigation is from tanks. But the problem of fodder in the winter months can very easily be eliminated if Napier grass is turned into silage from the last few cuttings in the rainy season. Until the cultivators are taught to grow Napier grass on a few bighas of their land it would be very difficult for them to face the fodder problem for their cattle.

In the year 1924 one pure Sindhi bull and one cross-bred Sindhi bull were purchased from the Agricultural Farm, Dacca. A few graded cows by the Sindhi bull showed good results as regards milk production and health. But in the year 1928, Mr. William Smith, the Imperial Dairy Expert, recommended the Hariana breed for the improvement of Gosaba cattle. Hence Sir Daniel Hamilton purchased from the Punjab a dozen Hariana cows and half a dozen bulls of the same breed. But after two years' trial this breed was found to be a total failure as some cows and bulls died of some unknown diseases. Further the average yield of milk of the cows was 20 lbs. in the Punjab. But when those cows reached Calcutta, the yield of milk came down to 12 lbs. and when the herd reached Gosaba the yield of milk of the cows went down to 6 lbs. So further improvement by Hariana was stopped and the remaining herd had to be removed to Baripada (Mayurbhanj) where Sir Daniel Hamilton had another estate.

Sir Daniel Hamilton then avoided all other breeds for the improvement of Gosaba cattle and finally decided to carry on his breeding work with the Sindhi breed as he got better results from them. Thus in the year 1931 the Agricultural Department, Bengal, supplied the estate with two pure Sindhi bulls free of charge but the railway freight was borne by the estate.

In the year 1936 Dr. Higginbottom and Dr. Schneider of the Allahabad Agricultural Institute paid a visit to

Gosaba and they both encouraged the work of cattle improvement of this place. Dr. Schneider during this visit delivered a lecture on the subject of cattle improvement, and he also promised to render all possible help along this line. Thus in the same year three Sindhi bulls and a few cross-bred cows were purchased from the Allahabad Agricultural Institute. Those Sindhi bulls are still in good condition, but one of the cross-bred cows died of rinderpest in the year 1939. Another cross-bred cow gave up to 30 lbs. of milk, but after a few months the milk became saline and she never came in heat.

The Sindhi bulls purchased from Allahabad were mostly used for grading the village cows After four years' trial it was confirmed here that Sindhi breed was more successful than all other breeds which had been tried here for grading purposes. The yield of milk of the F_1 grades of Sindhi was considerably high in comparison to the grades of Montgomery and Nellore. This breed is also more resistant to the saline and damp climate of this place. A table is given below from which one can easily notice the gradual improvement of the Sindhi grades of this place:

Dams.	Av. milk yield.	Days in milk.	Daughters.	Av. milk yield.	1st lactation. Days in milk.
A	5 lbs.	240	A_1	7½ lbs.	280
B	4 lbs.	225	B_1	6 lbs.	270
C	3 lbs.	220	C_1	5 lbs.	270
D	2½ lbs.	265	D_1	4 lbs.	290
E	1½ lbs.	326	E_1	2½ lbs.	365

The above cows are fed with Napier and *doob* (*Cynodon dactylon*) grass in the summer months and they solely depend on paddy straw in the winter months. Further the cows are sent out twice daily in the winter months and also in the summer months for grazing in the fields. Wheat bran, ground pulses and mustard cake are

the available concentrates which are fed to the above cows in the ratio of 1:2½. There is also a difficulty with the heifers which mature very late. In order to eliminate this difficulty improved feeding was tried but the problem has not yet been solved.

In the year 1940 the Manager of Sir Daniel Hamilton's estate approached the Live-stock Expert, Bengal, to supply the estate with a few pure Sindhi bulls, but he was discouraged by him. In spite of this discouragement by the Live-stock Expert, the Manager of the Estate, who was fully convinced of the better results of the Sindhi grades, persuaded the Live Stock Expert to furnish him with all necessary details of the reliable sources for purchasing a few Sindhi bulls. Later the Live-stock Expert supplied two Sindhi bulls free of charge and suggested to the Manager of the Estate to purchase bulls from Karachi. In the year 1941 eight Sindhi bulls and a pure Sindhi cow were purchased from Karachi. The cow was purchased with the idea that pure Sindhi bulls would be produced here locally. In Karachi this cow has given 20 to 24 lbs. of milk in three milkings but here she has given up to 16 lbs. of milk in two milkings when fed only with paddy straw and concentrates in the ratio of 1:2.

The bulls purchased from Karachi are now stationed here in different breeding centres of Gosaba. To have a thorough and systematic improvement the Live-stock Expert, Bengal, was requested to help the estate with an officer of his department for castrating the undesirable bulls of this place; and thus in the month of May, 1941, about 300 undesirable bulls were castrated. This has helped much for the thorough breeding of the village cattle as the villagers are forced to use the Sindhi bulls instead of the undesirable ones.

No substantial improvement in the way of breeding is, however, possible until cattle can be better fed. The crux of the situation is the period of scarcity which, in most, though not in all parts of the country, is the two

(*Continued on page* 295.)

NAPIER GRASS

A NEW FODDER CROP FOR THE UNITED PROVINCES

By

B. M. Pugh,

Allahabad Agricultural Institute

The grass is sometimes known in this country as Elephant grass. Its scientific name, that is one that is known all over the world, is Pennisetum purpureum. The grass is considered to be a native of Africa and to have been introduced into this country about the year 1915. Since then, the grass, because of its very high yield, has become one of the most important fodder crops in Government farms and also in private dairy farms.

The grass is very tall, growing to a height of about 6 to 10 feet, and branches profusely. These branches, known technically as tillers, increase every year so that the clump may be even three or four feet wide. The plant resembles sugarcane in general appearance, and is also propagated almost like sugarcane, that is by stem cuttings. But the most successful method of propagating Napier grass is by rooted stems. That is, from a clump of Napier grass, tillers are removed, and the portion of the stem possessing roots are cut off for "seed" purposes This is the most common and most effective method. Seeds do not generally form and are almost always not viable. So the method of propagating by seed is not resorted to in Northern India But there is a variety of Napier grass which forms seeds more readily than others. But the yield of this variety is not as large, although it is considered to be more drought resistant. We have had very little experience with this latter variety and so cannot at present recommend this, although we hope to be able to do so later.

If these rooted stems are used for seed, the amount used per acre on this farm has varied from 12 to 15 maunds. We recommend planting in rows, either in a furrow during dry

seasons or in ridges during very wet seasons at distances of about 3 feet from row to row and 2 feet from plant to plant in a row. For very fertile soils these distances may be further increased. The best planting time is during the rainy season.

The grass grows in almost any type of soils if it contains, or is supplied with, plenty of organic matter such as farm yard manure. However clayey soils or soils that have a tendency to be water-logged should be avoided.

The crop once planted, lasts for several years. On the Institute farm the grass has been in some fields continuously for eight years. The yield, however, after some years, decreases, especially if it is not manured heavily. But we have been getting average yields of 2800 maunds an acre a year from about five or six cuttings under sullage irrigation.

The grass compares favourably with juar; and if cut before it flowers, is fairly succulent. The grass is also relished by cattle, that is cows and buffaloes The grass is generally fed to animals after cutting by a chaff-cutter, as is done at the Institute, or by a *gandasa*, as is customary in villages.

The Allahabad Agricultural Institute supplies Napier rooted stems at Rs. 3 a maund and stem cuttings at Re. 1 a maund.

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or three months preceding the break of the south-west monsoon. It is the hardship endured throughout this period that, more than anything else, makes the cow an irregular breeder, and reduces her natural milking qualities until she is unable to suckle a healthy calf. This leads to the scarcity of good bullocks.

Sir Daniel Hamilton has spent more than fifty thousand rupees for the improvement of cattle in his estate, but he is no more in this world. At present his worthy manager is taking more active part in cattle improvement than anybody else in the estate I hope a time will come when other Zamindars of Bengal will follow the ideals of this place and remodel their Zamindaries like an unique Estate of Gosaba, which I think, is the only one in India.

SEWAGE DISPOSAL

By

J. C. Barpujari, B.Sc. (Ag.)

The two greatest conveniences of the home are (1) a system of running water, and (2) a sanitary method for disposing of sewage. Much advancement has been made towards supplying running water system in city and in some rural areas, but there has been very little advancement towards sanitary sewage disposal in rural areas and some parts of the cities too; while this is equally or more important than the system of running water.

The evil effects of unsanitary sewage disposal are more than can be enumerated at a glance. A sanitary method of sewage disposal removes from the back yard the unsightly and filthy mess, changes the form of the place from an unhealthy to a healthy one, and supplies conditions where the disease breeding flies and other organisms will cease to flourish.

Study and use of sewage disposal systems are of prehistoric origin. Historical studies in this line reveal that several ancient civilizations had sounder ideas on the subject of sewage disposal than generations which followed them. Instances of irrigating city gardens with sewage water in olden days in Rome, Alexandria, Jerusalem, Persia, etc., have contributed a great lot to the modern methods of sanitary sewage disposal. Instances of cities grown into magnificient existence but blotted out by uncontrollable epidemic death, are not very uncommon and it is agreed that water-borne diseases, created by inadequate sewage disposal, were in many cases responsible for these historic tragedies.

To-day sewage disposal is gaining rapid recognition by the entire world. But the fact remains that while city sewage disposal is receiving honourable recognition; outlying communities, villages and rural areas are growing rich in the

danger of water-borne death through careless sanitary measures.

It is easy to have any sort of modern sewage disposal system in the city and the cost per head will remain quite low because of the density of the population; but in the thinly populated areas, even though the simplest of methods are considered, the cost per head for any modern system of sewage disposal becomes very high. That is why public sewage disposal systems are not possible in rural areas.

The city sewage plants have already obtained great attention, deep study and very wide technical development; but the less attractive small plants for rural use have been greatly neglected. For India, the sewage disposal problem is essentially rural, and therefore the study and development in this line must be different from those in the case of cities.

Definition of Sewage.

In a broad sense of the term, 'sewage' means all the liquids and other matters which flow through a sewer from the bath-tub, wash and kitchen sinks, water closet and laundry tubs. This term alludes to the contents of the privy vault, dry earth closet, slop water basin, cesspool or the septic tank. The term generally applied to sewage as it flows from the sewer to the final place of disposal is 'effluent.'

Methods of Sewage disposal.

Methods of sewage disposal can be conveniently divided into two general classes, namely : (1) dry sewage systems, and (2) water carriage systems. The former has got popular due to its cheapness, and is of general use in rural areas all over India and other parts of the world. Another reason for its common use is that any small unit, may be one individual or a family, can afford to use it without the botheration of seeking for wide co-operation or huge expenses; while any water carriage system means a little more expense and general co-operation of the public in certain cases.

Dry Sewage Methods.

Under this head two methods may be mentioned which are of common use in the country : (1) The privy vaults, and (2) earth closets.

Both of them are crude but they work very satisfactorily without any fear regarding sanitation if proper care is taken in regard to their arrangement, location and operation.

1. The privy vault as we usually see in the country consists of a small frame building over a pit which receives the refuse or fecal matter. For a time such a receptacle is satisfactory; but unless properly cared for it becomes a nuisance, obnoxious both to sight and smell as well as to health. This danger can be avoided by a generous use of lime while in use and by avoiding once for all or by removal of the waste from the pit.

A privy vault is a scurce of danger and of water pollution if it is near any well, cistern or any other source of water supply. The privy vault often becomes a fly breeding place. And flies do transmit disease, notably typhoid fever, dysentry, cholera, etc. So a good privy vault should be inaccessible to flies. Use of screens in the closet and dry air-slaked lime in the pit daily will keep the flies away.

The following precautions are necessary:—

(1) No privy vault should be within one hundred feet of any source of water supply.

(2) Excreta should not be accessible to flies and should be removed from time to time from the vault, or the vault should be covered up and avoided after it is filled to a certain limit.

(3) Location of a privy vault should be such that the liquid waste will drain away from the premises into a ditch away from any source of water supply.

2. Earth Closets is anothr dry sewage system which is popular in rural as well as town areas next to privy vaults. It is simple and in many respects an entirely satisfactory substitute for a privy.

All that is needed in an earth closet is a common closet, a supply of dry earth, a water-tight receptacle beneath and a convenient way of disposing of its contents at frequent intervals. The receptacle, unlike in the privy vault, should be wholly above ground, and may consist of a metallic lined box or half of a kerosene barrel with handles on it for removal, or better still a galvanized iron pail. The receptacle may be removed through a door at the back of the closet. Each time the closet is used a small amount of dry earth is added over the refuse to deodorize and render harmless the waste matter. The earth should be common garden or field loam finely pulverized. Road dust does well but sand is not suitable. Ashes are entirely satisfactory for this purpose.

Authorities on the subject of sanitation recommend the dry closet rather than the privy vault because it is far more sanitary and becomes less of a nuisance.

The Water Carriage Systems.

A Bore-Hole-Latrine:—Throughout India, a popular development of the cesspool is growing into extensive favour among rural uplift workers. The structure is commonly called bore-hole-latrine. A bore hole-latrine is a very good device for disposing of waste-material.

The bore-hole-latrine consists of a deep hole bored about 25ft. deep. The hole is 18 inches in diameter, with a squatting seat on the top. The whole system has a simple building over it or a screen round it for privacy. The advantages in this system is that flies cannot breed in it, no bad odour is produced, and after the hole is filled and kept covered for about a year, the waste matter turns into a very good manure, which is priced as much as Rs. 10 a hole.

It has got its bad sides too. It concentrates the waste matter below ground surface away from many of Nature's natural purifying processes. For the villager to whom a bore-hole-latrine could be of service, this sub-soil contamination becomes a serious consequence in as much as he is invariably dependent upon surface water from tanks or shallow

wells. In spite of its usefulness a bore-hole-latrine may be a source of danger if put by a careless builder near any source of water supply.

The Cesspool:—

The general definition of a cesspool is a tank into which the house sewage is discharged, the tank retaining the solid and sometimes the liquid matter until removed. Cesspools are of two types: *viz.*, leaching and tight cesspools.

The leaching cesspool is built of loose brick or stone without the use of cement or mortar. Through the crevices in the sides of the cesspool the liquids leach out into the surrounding soil, leaving the solid matter in the cesspool until removed by pumping or similar methods.

The tight cesspool is built of brick or concrete and is water tight. The liquid is removed by being drained out through a drain pipe. The solids are removed as in the leaching cesspool.

Cesspool of any type is generally covered over leaving only small air vents or a manhole on the top.

The main objections against cesspool are:

1. The leached out effluent is not purified or free from germs although it may be a clear liquid. So one should be very careful in locating a cesspool in regard to any source of water supply.

2. The watery effluent transports digested silt like solids into the seepage areas thus making the cesspool so water tight that it is quickly filled with watery effluent and flooded. Cesspools are in common use in many parts of the world.

The Septic Tank:—

A desire to control the escapement of pathogenic bacteria through the cesspool encouraged the development of an impervious box-like tank to replace the cesspool and receive the sewage. The result was the modern septic tank. This is sometimes called a scum tank or putrefaction tank,

and consists essentially of a water tight chamber of suitable capacity through which the sewage flows slowly and almost continuously, the inlets and outlets being submerged to prevent an undue disturbance of the surface of the scum. At present in practical use, the septic tank has a very wide recognition The small unit serving residence or adjoining buildings works very successfully while Municipal units serving larger areas contributing mixed sewage consisting of storm run-off, domestic sewage and industrial waste need various modifications over the simple design, for the work they are expected to do.

Aggressive educators, specially Agricultural Engineers in America, have carried on experiments so as to render the *septic tank* universally useful. The usefulness of septic tank has been greatly enhanced by providing it with the aid of a sewage treatment plant.

Septic tanks may be closed or open. For residential buildings it is preferable to use covered tanks for the reason that bad odours are confined within the tank; the sewage scum is concealed from the sight; the surface in the tank is protected from wind, rain, etc; and the most important of all is that the probable infection of food in the house by flies is prevented.

A septic tank. usually consists of two chambers which may be called the settling tank and the flush tank. Sewage enters the first tank through an inlet pipe from the house. A heavy scum forms over the surface of the sewage which is liquified by the action of bacteria which develop or grow in the surface scum. For successful growth or culture of these bacteria which leads to the proper functioning of the tank, the scum must not be frequently broken or disturbed, hence the inlet pipe is made to discharge below the surface of the liquid. For the same reason the overflow pipe from the first to the second tank is extended below the surface to about the middle of the first tank where the liquefaction of sewage is most complete.

After passing through the flush tank the sewage may be discharged directly into a creek or running stream as is usually done in many places. Under most conditions, if a running stream were not available, the effluent may

be discharged into a ditch or other drainage branch which should preferably be at least 100 yards, away from the house. In many cases the effluent is led into underground distributing channels made under garden soil with solid and broken bricks.

When the effluent is discharged directly into a running stream of sufficient flow the flush tank can be omitted. If the sewage is treated by sub-surface irrigation, then the flush tank is always advisable to be used for a better intermittent delivery of the sewage.

For inspection and removal of sediments from the tanks, manholes on the tops, and valves at the bottom, of the tanks respectively are provided with.

In septic tank sewage disposal systems, as in all other systems of the like, some provision must be made for the effluent after it leaves the tank. It is of great importance in that upon this, depends the success of the system. In the absence of running streams into which to empty it, some other means of disposal must be resorted to. The most common and which may be called the only method that may be used in a flat country is the sub-surface disposal scheme.

Sub-surface disposal means the disposal of the liquid sewage through a system of open jointed tile drain laid from eight to twelve inches below the surface of the ground. The open joints should be from one-fourth to one-half inch apart, and covered with some material to prevent loose earth from falling back into the pipe during the backfilling of the ditch. The length of the drain pipe depends upon the amount of sewage and nature of soil. For lateral drains a three inch tile is ordinarily used. Broken and solid bricks may very satisfactorily replace the tiles.

Surface Disposal of Sewage:—

This is performed in various ways. As in the previous case it is essential that the sewage be discharged upon the surface of the ground intermittently. This gives enough time for putrefaction in the soil, and prevents water-logging. In this case the effluent is mostly used for irrigation purpose. The disposal pipe from the septic tank carries the sewage on to the field and empties it into a ditch which runs along the

highest portion of the field. This ditch feeds lateral distributing channels which are distributed at certain required intervals of space all along the main ditch. These channels in their turn carry the sewage to the furrows alongside the rows of crop or to flat areas for a flooding type of irrigation.

Direct Disposal System:—

In cases where sewage cannot be otherwise utilized it is advisable to dispose of the sewage directly into a running stream, but this method should not be accepted as the best. The danger is that the water farther down the stream sometimes used for drinking purposes may be contaminated or it may be so fouled as to be unfit for any other purpose. On the other hand if the flow of the stream be large, the dilution will be so great that little or no danger will occur from its contamination by the sewage.

Disease germs may be carried for distances of several miles, hence there is always danger in using water for drinking purposes from any river where sewage is emptied.

In direct disposal system the sewage should always be carried through either cement jointed clay pipes or metal pipes so that there is no danger of polluting the soil by leaching of the sewage while on the way.

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CULTIVATION OF MAIZE*

By

SYED RAZI HAIDAR NAQVI, B.Sc. (AGRI.)
SABOUR

Suitable number of plants per hole:—

Much work has been done in other countries on finding out the suitable number of plants to be raised from a single hole and at the Minnesota Experimental Farm, it has been concluded that highest yields are obtained by growing 4 plants per hole. As such work has not been undertaken in India, an attempt was made to tackle this side of the problem as well during the current season, and Kalimpong maize was selected for this purpose. Kalimpong is a very tall variety of maize and hence at sowing, $2\frac{1}{2}'$ distance was kept from line to line and 27' from plant to plant. In the 1st line the healthiest seed at the rate of 2 grains per hole, in the 2nd line 3 grains, in the 5th line 6 grains and in the 6th line 7 grains per hole was sown. As soon as the seeds began to germinate, fresh seed was put at places where there was a slightest doubt of getting less number of plants. When the seedlings were about 6″ high, thinning was done in such a way that the 1st line had 1 plant per hole and the 2nd, 3rd, 4th, 5th and 6th lines had 2, 3, 4, 5 and 6 plants per hole respectively. Six such lines were replicated six times and in this way it was possible to compare the outturn of lines with 1 to 6 plants per hole.

From the general stand of the crop it was observed that there was no distinct difference in the height of plants but as the number of plants increased beyond 2, the plants appeared to be paler and weaker. The weakness was specially noticed in such characters as the thickness of stems and the

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* Translated and reproduced, a portion of the article from Bihar Hindi—Kisan. Vol. 8; Part 8; on p. 319-20 January, 1940. (Pp. 311—321).

length and breadth of leaves. There was a marked reduction in the above characters of stems and leaves for the simple reason that the plants in lines with higher number of plants per hole got less food and light as compared with the less crowded lines. As regards the outturn, the produce of each of the 6 line sets of the six treatments at six random places is given below :—

Particulars.	Produce from an area of 400 sq. ft. *i.e.* 40 ft. long and 10 ft. broad strip of land.	Yield per Acre.
	Md. sr. ck.	Md. sr. ch.
1 Yield from lines with 1 plant per hole.	0 6 14½	18 32 1
2 ,, ,, ,, ,, 2 ,, ,, ,,	0 10 5	28 3 1
3 ,, ,, ,, ,, 3 ,, ,, ,,	0 7 9½	20 26 15
4 ,, ,, ,, ,, 4 ,, ,, ,,	0 6 4½	17 29 0
5 ,, ,, ,, ,, 5 ,, ,, ,,	0 5 12½	15 29 9
6 ,, ,, ,, ,, 6 ,, ,, ,,	0 5 10	15 12 9

From the above figures, it is evident that the yield from lines with 2 plants per hole was the highest. The produce from lines with 3 plants per hole was second in importance but the ears in this case were smaller and had less number of grains whereas the total number of ears was much greater than that of the other two lines. The rest of the lines presented a very poor show and in fact they were more suited for fodder crop rather than for grain.

From this year's experiments, it is concluded that late ripening variety of maize, if sown in lines with 2 plants per hole, gives appreciably higher grain yields. It is now proposed to conduct expriments, if possible, with early ripening varieties as well the next year.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES

FOR AUGUST, 1941

I—Season.—The rainfall during August, 1941, was general and above normal in 15 districts. Rain is still needed in certain parts of the province.

II—Agricultural Operations.—Agricultural operations are generally up-to-date except where the July drought has delayed kharif sowings. Preparation of land for rabi, transplantation of late rice and weeding of kharif crops are in progress.

III—Standing Crops and IV—Prospects of the Harvest.—The condition of the standard crops is on the whole satisfactory and the prospects more or less favourable.

V—Damage to Crops.—Some damage to crops is reported due to floods in the Cawnpore, Jalaun and Bahraich Districts and for want of rain in the Aligarh, Pilibhit, Almora, Sitapur and Rae Bareli Districts.

VI—Agricultural Stock.—The condition of agricultural stock is generally satisfactory. Cattle disease is reported from almost every district. Haemorrhagic septicaemia and foot and mouth diseases have increased to some extent while rinderpest is on the decrease as will be seen from the following figures furnished by the Director of Veterinary Services, United Provinces.

Disease	July, 1941		August, 1941	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	1,908	985	989	515
Foot and mouth	6,988	43	9,669	70
Hæmorrhagic Septicæmia	1,130	964	1,407	1,208

VII—Pasturage and Fodder.—Fodder and pasturage are reported to be sufficient from a large number of districts,

although conditions in some of the western districts and in Jhansi are not entirely satisfactory.

VIII—Trade and Prices.—The prices of the chief food grains, such as wheat, barley, gram, rice and arhar dal have risen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :—

	End of July, 1941	End of August, 1941
Wheat	4·275	4·404
Barley	2·826	2·836
Gram	3·472	3·544
Rice	6·201	6·575
Arhar dal	4·347	4·371

IX—Health and Labour in Rural Areas.—The condition of agricultural labour is on the whole satisfactory. Cases of cholera are reported from a few districts.

For September, 1941.

I—Season.—The rainfall during the first three weeks of September, 1941 was general and widespread. There was however no rain during the last week in Meerut, Agra, Rohilkhand, Allahabad and Jhansi Divisions. More rain is needed.

II—Agricultural Operations.—Preparation of land for *rabi* crops and the sowing of the same is in progress. Harvesting of *kharif* crops and picking of cotton continue. Irrigation of sugarcane and paddy is taking place in canal areas.

III—Standing Crops and IV.—Prospects of the Harvest.—The condition of the standing crops is on the whole fairly satisfactory except in certain districts where crops are reported to be withering for want of rains. The prospects seem favourable.

V—Damage to Crops.—Some damage due to floods, locusts and insect pests is reported in the Bahraich, Ballia, Muttra and Partabgarh Districts and for want of rain in the

Aligarh, Muttra, Moradabad, Fatehpur, Jhansi, Gorakhpur, Almora, Rae Bareli, Sitapur and Kheri Districts.

VI—Agricultural Stock.—The condition of the Agricultural stock is generally satisfactory. Cattle disease is reported from 32 districts. Haemorrhagic septicaemia and rinderpest disease have increased to some extent and foot and mouth to a large extent as will be seen from the following figures furnished by the Director of Veterinary Services, United Provinces :

Disease	August, 1941		September, 1941	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	989	551	1,209	641
Foot and Mouth	9,669	70	12,233	48
Hæmorrhagic Septicæmia . ..	1,407	1,208	1,549	1,298

VII—Pasturage and Fodder.—Fodder and pasturage are reported to be sufficient in a majority of the districts, although conditions in some of the western districts and in Kheri are not satisfactory from this point of view.

VIII—Trade and Prices.—Prices of the chief food grains show a tendency to rise except that of rice. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

	End of August, 1941	End of September, 194
Wheat	4·404	4·614
Barley	2·836	3·069
Gram	3·[illegible]44	3·670
Rice	6·755	6·534
Arhar dal	4·371	4·487

IX—Health and Labour in Rural Areas.—The condition of Agricultural labour is satisfactory. Cases of cholera are reported from a few districts.